Building the NOAA Environmental Real-time Observation Network

Site Installation Plan
March 4, 2005

Draft Version 1.1

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service

Signature/Approval Page

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Site Installation Plan

Approved:

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Office of Science and Technology	**Office of Climate, Weather, & Water Services**
Date: _____	**Date: _____**

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Table of Contents

List of Figures

List of Tables

1 Introduction

The installation procedures in this document are intended to ensure a uniform station configuration and to maximize safety, data quality, and equipment reliability across the NOAA Environmental Real-time Observing Network (NERON) — formerly known as the Modernization of the Cooperative Observer Network. The intent is to provide NWS Management and external organizations contracted to install NERON stations with explicit and clear instructions about how the Integrated Surface Observing Systems (ISOS) Program Office at the National Weather Service expects the equipment and sensors to be installed. The goal is to reduce confusion and cost, resulting in a world-class climatological and meteorological observing network.

This document contains diagrams showing configurations for sites with 3 different plot sizes and for sites with a two-meter mast, a single 7-foot tower section, or a full-height tall tower. The 10-foot-by-16-foot and 16-foot-by-20-foot plots will accommodate a mast, while only the 20-by-40-foot plot will accommodate the taller towers, due to the additional space needed for guy wires, and expansion, in the case of the 7-foot tower section station. While the configurations specified are the goal, situations will occur when the installer must deviate from the ideal configuration. In these cases, all deviations must be documented photographically and on the 'as-built' drawing included in the appendix of this document.

Detailed instructions also are included on installing and calibrating the GEONOR precipitation gauge, installing the operational prop vane wind sensor, and installing soil moisture/temperature sensors. The appendix includes checklists for equipment and materials used in each kind of station, installation checklists for each kind of station, a precipitation/gauge calibration worksheet for the GEONOR sensor, an as-built drawing form, and a station installation metadata form. The equipment and materials checklists are designed to be aids in acquiring and packing equipment for individual installation trips. The installation checklists are intended as an aid in double-checking that all required installation tasks have been completed at each station; these forms must be submitted to the ISOS Program Office as certification to that effect within one week of installation. The station installation metadata form is official documentation for the ISOS Program Office of the specific equipment installed and the configuration of each site and station.

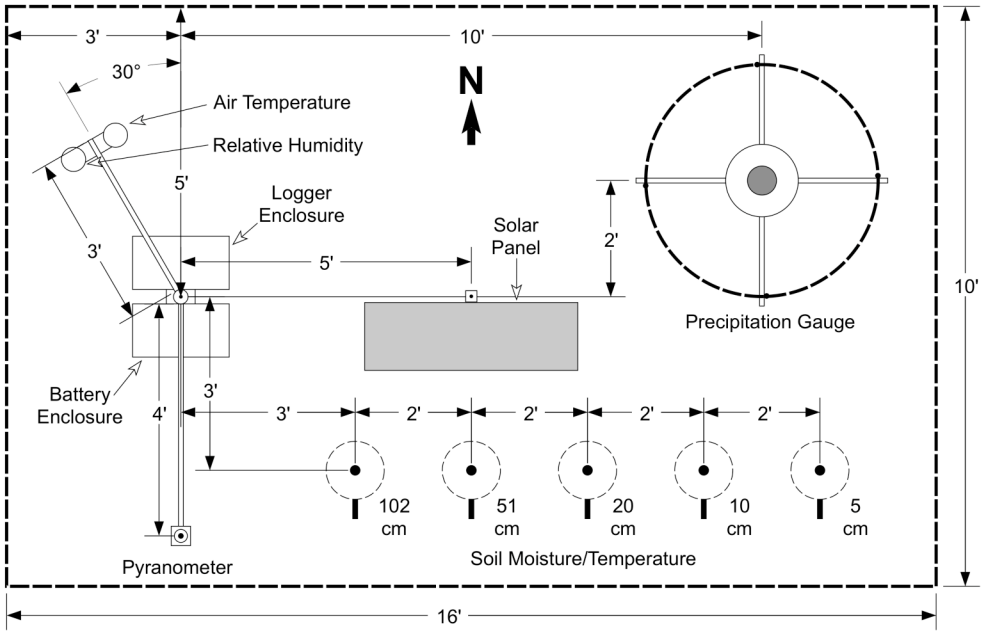

Figure 1. Plan view of a station plot that measures 10-by-16-feet.

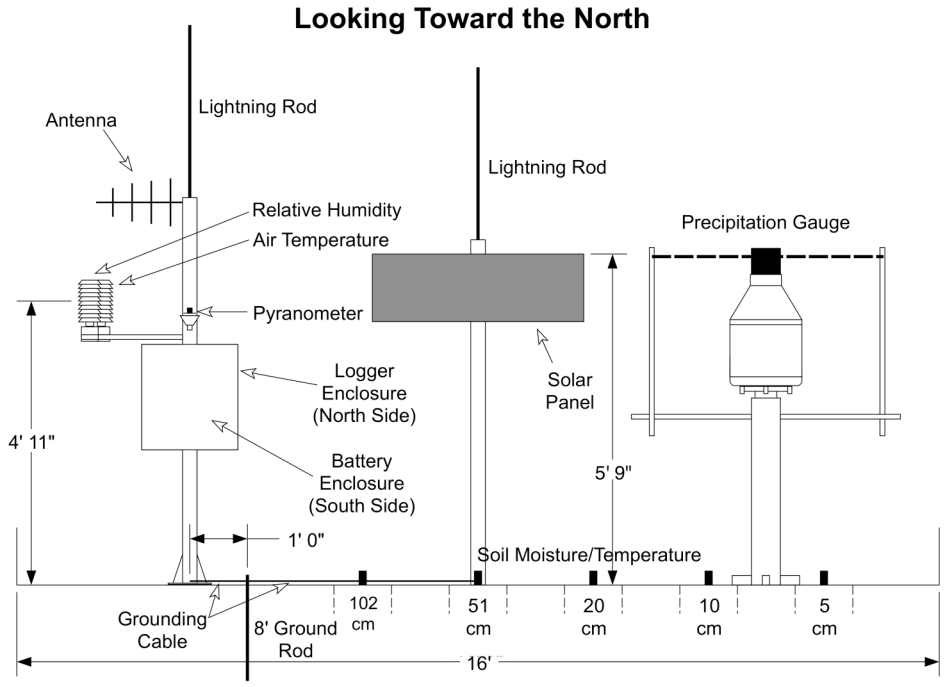

Figure 2. Profile view of a station plot that measures 10-by-16-feet.

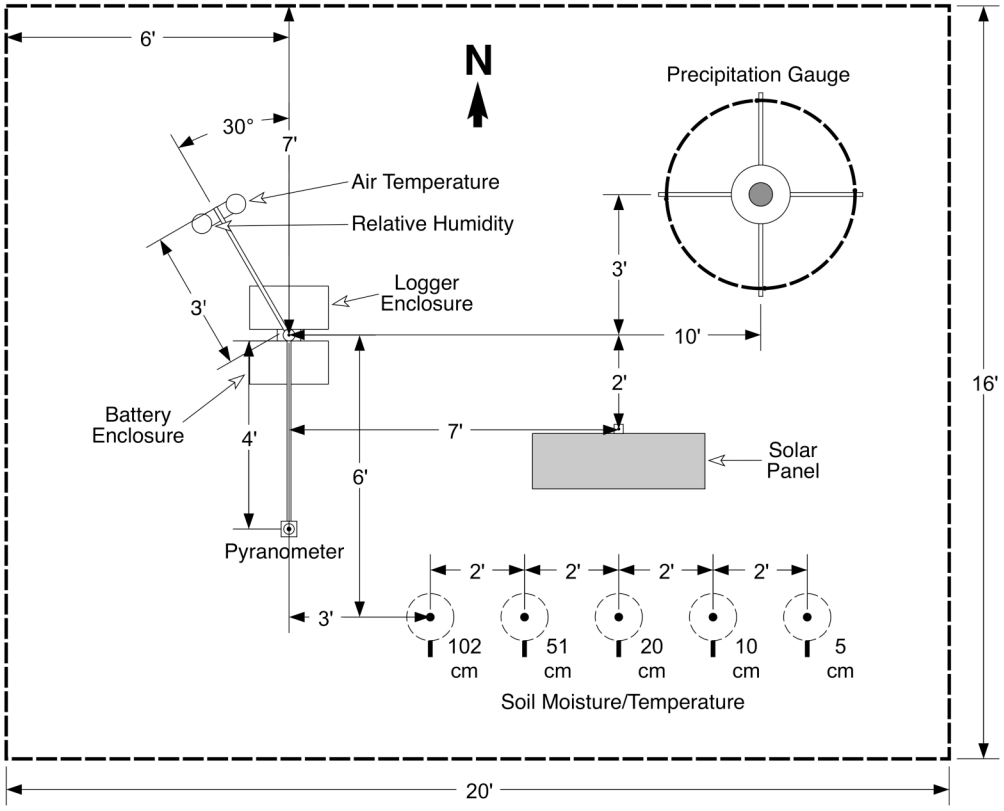

Figure 3. Plan view of a station plot that measures 16-by-20-feet.

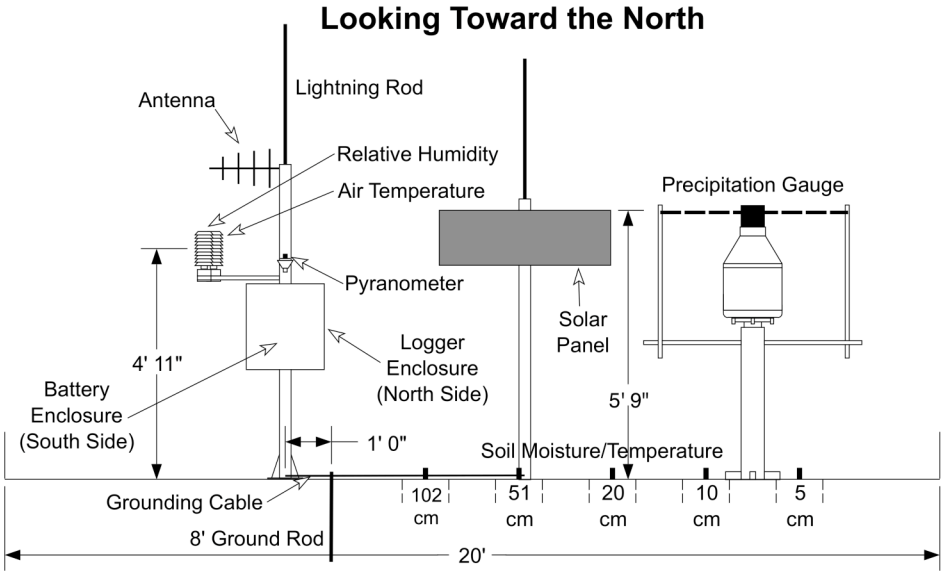

Figure 4. Profile view of a station plot that measures 16-by-20-feet.

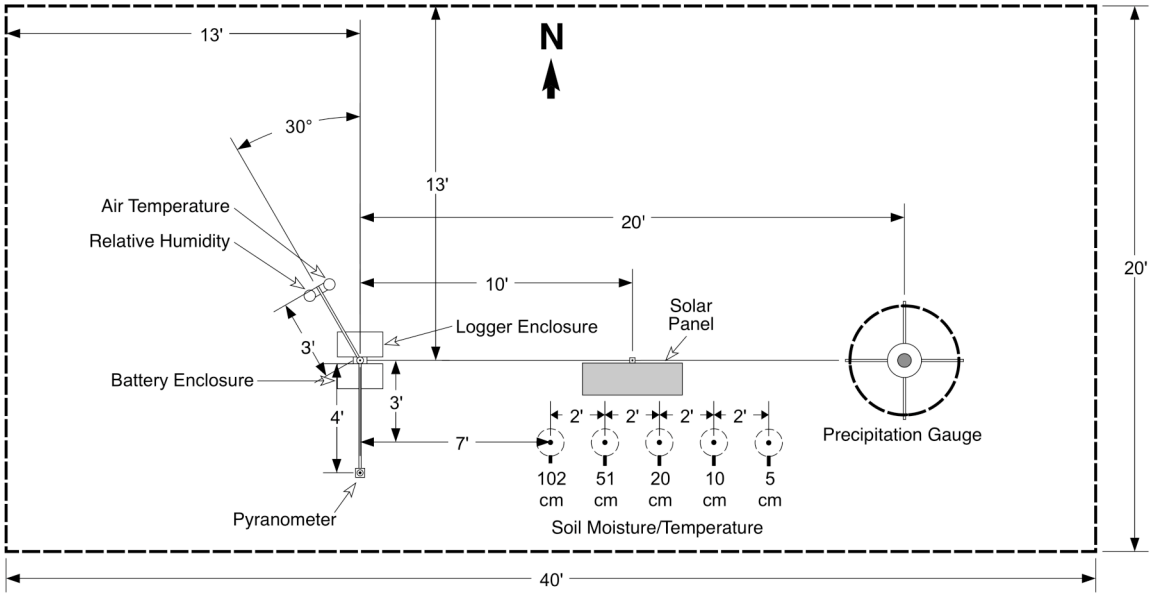

Figure 5. Plan view of a station plot that measures 20-by-40 feet and has a two-meter mast or tower.

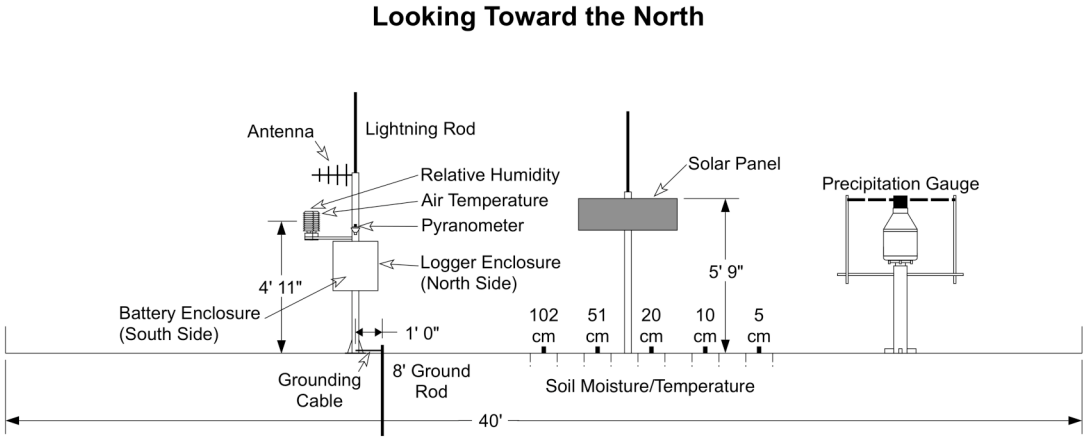

Figure 6. Profile view of a station plot that measures 20-by-40 feet and has a two-meter mast or tower.

2 Procedure for a Site with a Two-Meter Mast or Short Tower

A site chosen for the installation of a two-meter mast or short tower (a tower that is 2 meters tall or less and is tapered at the top) has been determined not to have adequate exposure for the installation of an operational wind sensor and will not be expanded to a site with a tall tower.

Note: Refer to Figures 1 through 6 above for the positions and configuration of the equipment. Use the largest of the three plot sizes allowed by the landowner. If the equipment will be installed using a two-meter, three-sided tower that is tapered at the top, rather than a mast, refer to Figures 7 and 8

on Page 9 for the proper positioning of equipment mounted to the tower. In addition, these procedures cover installation for potential sensors that could be installed at a two-meter mast site. Not all potential sensors will be installed at every site.

Note: All compass directions referred to in these procedures are referenced to true north.

1. Obtain verification that the site is clear of underground utility lines or, if any are present, that their locations are marked and they can be avoided before digging.
2. Obtain information on the depth of the frost line if concrete foundations will be installed.
3. Complete all pre-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 31. In addition, as installation progresses, document deviations from the standard configuration and any other notable findings, as described in the photographic documentation section.
4. Measure and mark the extent of the plot, assuming the stake placed by the surveyor represents the exact center of the plot.
5. If necessary, cut the vegetation in the plot as low as possible to make installation easier; plan for its maintenance at this level.
6. Attach the lightning rod to the top of the main mast/tower, routing the grounding cable to the bottom of the mast.
7. Install the steel screw or concrete foundation for the main mast/tower, at the distances from the north and west sides of the plot shown in Figure 1 for a 10-by-16 foot plot, in Figure 3 for a 16-by-20 foot plot, and in Figure 5 for a 20-by-40 foot plot. If concrete and/or special drilling or boring is required, take a photo before pouring concrete or installing any equipment on the foundation, as explained in the photographic documentation section beginning on Page 31.
8. Install the steel screw or concrete foundation for the precipitation gauge at the distances east and north of the mast/tower shown in Figure 1 for a 10-by-16 foot plot, in Figure 3 for a 16-by-20 foot plot, and in Figure 5 for a 20-by-40 foot plot, and when the precipitation gauge foundation is ready, install the precipitation gauge pedestal.
9. Install the solar panel mast foundation, mast, and lightning rod at the distances east and north of the mast/tower shown in Figure 1 for a 10-by-16 foot plot, in Figure 3 for a 16-by-20 foot plot, and in Figure 5 for a 20-by-40 foot plot. If the mast is composed of a non-galvanized conductive metal, such as aluminum, the mast can serve as the path to ground from the lightning rod and a separate cable is not needed (the mast must still be grounded to the station ground rod, though).
10. When the foundations are ready, install the main mast/tower and precipitation gauge pedestal on their respective foundations. If a short tower, rather than a mast, is supplied, orient it so that one of the flat tower sides faces due south (i.e., the side extends east-west).

11. Drive the 8-foot, copper-clad steel ground rod into the ground 1 foot due east of the main mast.

    Note: If it is not possible to drive the ground rod fully into the ground in rocky soil or where the bedrock is shallow, then drive additional ground rods into the ground 1 foot due west of the mast, 1 foot due south of the mast, and 1 foot due north of the mast, in that order, to achieve a cumulative length of 8 feet of ground rod below ground level. Drive as few ground rods as necessary to achieve the cumulative length, but no more than four rods. After driving them, cut any excess so that no more than 1 inch of rod protrudes above ground level. In some locations where bedrock is very shallow (i.e., where it is impossible to achieve a cumulative length near 8 feet of ground rod below ground with four rods), use a grounding plate or mesh, rather than rods.

12. Install conduit between the main mast/tower and the solar panel mast. Extend the conduit at least one foot above ground level at both ends to prevent string trimmer or lawnmower damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.

13. Install conduit between the main mast/tower and the precipitation gauge pedestal, allowing enough length to route it up the precipitation gauge pedestal to the base of the gauge and to the tower leg holding the data logger. Extend the conduit at least one foot above ground level at the main mast/tower end to prevent string trimmer or lawnmower damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.

14. Attach the radiation shields for the air temperature and relative humidity sensor(s) to the end of their mounting arm. If both are used, the shields should protrude on opposite sides of the arm. Mount the arm to the mast oriented 30° west of north, with the vertical mid-point of the shields 4 feet 11 inches (1.5 meters) above the level of the ground directly below.

15. Attach the logger enclosure to the mast so that the door opens to the north, placing the top of the enclosure 1 inch below the attachment point of the air temperature/relative humidity mounting arm. If a short tower is supplied instead of a mast, install the logger enclosure on the northwest side of the tower at the height explained above.

16. If a separate battery enclosure is supplied, attach it to the mast facing due south, placing the top of the enclosure at the same height as the top of the logger enclosure, if the mounting bracket so allows. If a short tower is supplied instead of a mast, install the battery enclosure on the northeast side of the tower at the height explained above.

17. If used, attach the pyranometer mounting plate to the pyranometer mounting arm. Attach the arm, oriented due south, to the mast 1 inch above the attachment point for the air temperature/relative humidity arm.

18. Connect 6 AWG solid copper ground wires from the logger enclosure, from the main mast/tower, and from the solar panel mast to the east ground rod. Connect the east ground rod directly to each additional ground rod, if any, with 6 AWG solid copper ground wire, routing the wires at ground level to minimize tripping hazards. Use either copper or stainless steel acorn clamps for all connections.

19. Connect the grounding cable from the lightning rod to the east ground rod.

20. Attach the communication antenna at the top of the mast, oriented in the proper direction, ensuring that the top of the antenna is below the tip of the lightning rod. Route the antenna cable down the mast to the logger enclosure. Coil and secure any excess cable to the mast near the bottom of the logger enclosure. Eliminate excessive cable runs if possible.

21. Attach the solar panel to the solar panel mast, oriented due south, placing the top of the panel 5 feet, 9 inches above ground level. Use Table 1 as a guide to set the tilt angle relative to horizontal.

Table 1. Solar panel tilt angle (from *Design Aids for Small PV Power Systems*, Solarex Corp.).

Site Latitude (degrees)	**Tilt Angle (degrees from horizontal)**
0 - 10	10
11 - 20	Latitude + 5
21 - 45	Latitude + 10
46 - 65	Latitude + 15
> 65	80

22. If the station will be AC powered, run the power line to the base of the mast, if not already done. If visible, take a photo or photos showing where all underground AC lines are located in the plot, as explained in the Photographic Documentation of Station Installation section on Page 31. Sketch their locations in the as-built drawing.
23. Connect the battery(ies) to the regulator(s) and to the station equipment and verify that the station is powered up. If the voltage regulator(s) does not have a built-in circuit breaker or fuse protection between the battery and the station, inline fuses should be placed between the battery and the station and between the battery and the GEONOR rim heater, as specified in Table 2 below. (If AC powered, a surge suppressor and a circuit breaker should be placed between the AC line and the power transformer.) Then connect the solar panel (or the output of the power transformer, if AC power is available) to the regulator and verify that the battery is being charged. Powering up the station at this point will allow verification that the sensors become operational as they are installed.

Table 2. Current ratings of fuses to be installed between the battery and the station and between the battery and the GEONOR rim heater. The fuses should be ATO fast-acting automotive blade fuses.

Equipment	**Fuse Rating (amps)**
Station w/CDMA modem	3
Station w/GOES transmitter	5
GEONOR rim heater w/one 1-inch-wide strip	5
GEONOR rim heater w/two 5-inch-wide strips	7.5

24. Connect a computer or PDA to the data logger. Download and run the appropriate program/setup for the station, if it is not already stored in the logger.
25. Install, if necessary, and configure the LETS radio, cellular modem, or GOES transmitter. Verify that the standing wave ratio of the antenna system is within the acceptable limit, if a LETS radio or GOES transmitter, following the Radio-Antenna System SWR Test procedure on Page 23.

26. Install the air temperature probe (and relative humidity and pyranometer sensors when provided) and connect it to the data logger. Verify that the sensor readings reported by the logger are reasonable. Coil and secure any excess cable to the mast near the bottom of the logger enclosure, but eliminate excessive cable runs when possible.
27. Install the precipitation gauge, following the Amplified GEONOR Precipitation Gauge Installation procedure on Page 23.
28. If provided, install the soil moisture/temperature probes, following the Amplified Soil Moisture/Temperature Sensor Installation procedure on Page 29. Because the soil moisture/temperature probes will be connected to a multiplexer, ensure that one is installed in the logger enclosure.
29. Repair the ground over all trenches, so that the surface is smooth and is not a tripping hazard.
30. Install a fence around the perimeter of the plot, if it has been decided that one is necessary at the site. Allow for technicians and observers to easily open and latch the fence at the northwest corner.
31. If the logger enclosure is not fitted with a one-way valve that keeps moisture out and is not fitted with cable glands to seal all cable entry points, then place 16 units (16 oz.) of desiccant in the logger enclosure.
32. If the logger enclosure is not fitted with cable glands, then use sealing clay to seal all cable entry points.
33. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON data ingest and processing system has been established, and that data are being collected.
34. Complete all post-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 31.
35. Complete the as-built drawing, indicating variations from the standard NERON configuration.
36. Complete the station metadata form.
37. Submit the completed GEONOR calibration sheet, photos named as specified in the photographic documentation section, the completed as-built drawing, the completed station metadata form, and the completed installation checklist to the ISOS Program Office at the National Weather Service.

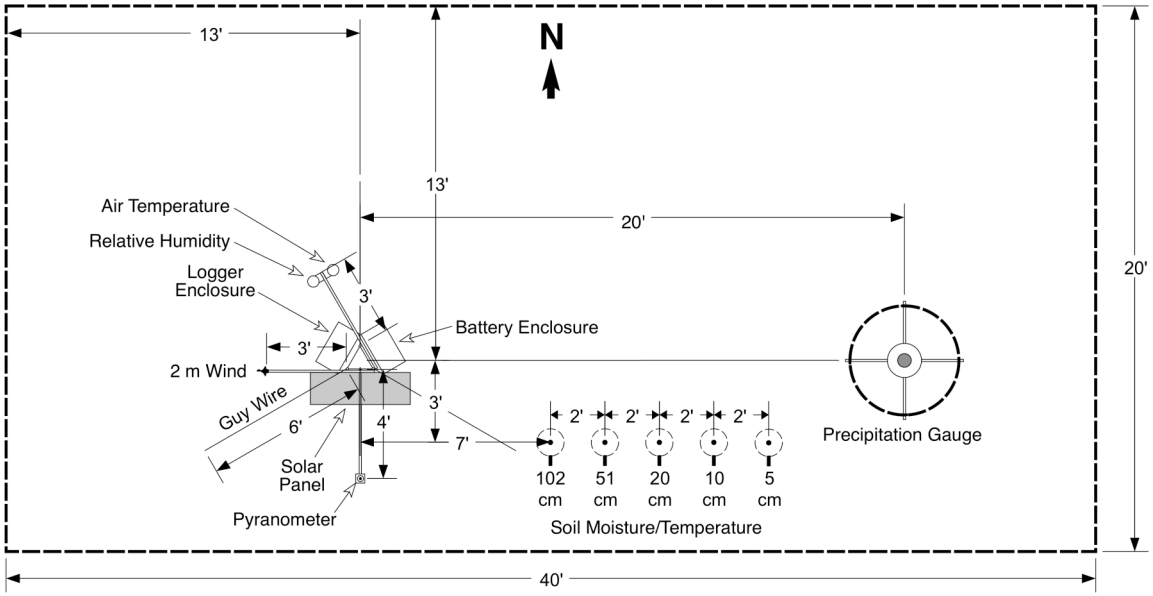

Figure 7. Plan view of a station plot that measures20-by-40-feet and has a single 7-foot tower section.

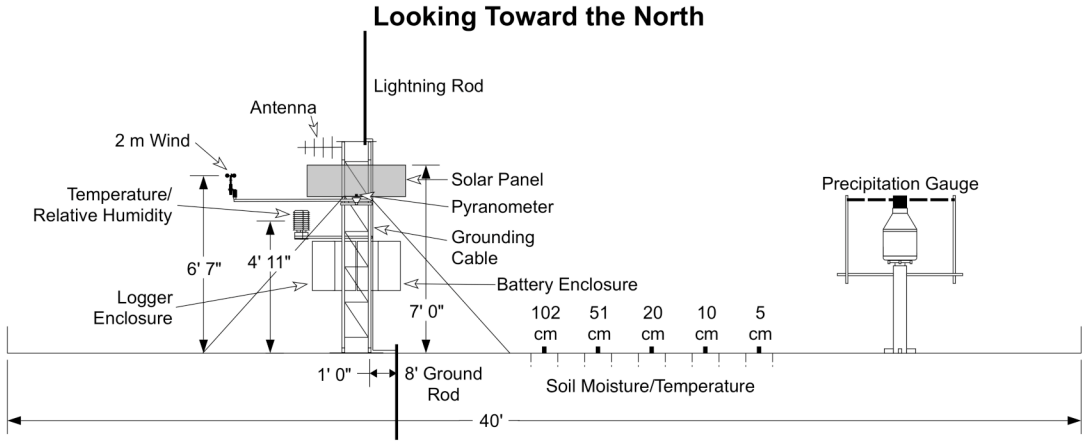

Figure 8. Profile view of a station plot that measures 20-by-40-feet and has a single 7-foot tower section.

3 Procedure for a Site with a Single 7-Foot Tower Section

A site chosen for the installation of a single 7-foot tower section has been determined to have adequate exposure for the installation of an operational wind sensor and may later be expanded to a site with a tall tower.

Note: Refer to Figures 7 and 8 above for the positions and configuration of the equipment. In addition, these procedures cover installation for all possible sensors that could be installed at this

type of site; not all of these sensors will be installed at every site.

Note: All compass directions referred to in these procedures are referenced to true north.

1. Obtain verification that the site is clear of underground utility lines or, if any are present, that their locations are marked and they can be avoided before digging.
2. Obtain information on the depth of the frost line if concrete foundations will be installed.
3. Complete all pre-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 31. In addition, as installation progresses, document deviations from the standard configuration and any other notable findings, as described in the photographic documentation section.
4. Measure and mark the extent of the plot, assuming the stake placed by the surveyor represents the exact center of the plot.
5. If necessary, cut the vegetation in the plot as low as possible to make installation easier; plan for its maintenance at this level.
6. Install the tower base plate with the center of the tower 13 feet east and 13 feet south of the northwest corner of the plot. The hinged side of the base plate should be to the northeast, with one of the flat tower sides facing due south (i.e., the side extends east-west). If concrete and/or special drilling or boring is required, take a photo before installing the base plate, as explained in the Photographic Documentation of Station Installation section beginning on Page 31.
7. Install the steel screw or concrete foundation for the precipitation gauge 20 feet due east of the tower, as shown in Figure 7, and when the precipitation gauge foundation is ready, install the precipitation gauge pedestal.
8. Install the solar panel mast foundation, mast, and lightning rod at the distances east and north of the mast/tower shown in Figure 1 for a 10-by-16 foot plot, in Figure 3 for a 16-by-20 foot plot, and in Figure 5 for a 20-by-40 foot plot. If the mast is composed of a non-galvanized conductive metal, such as aluminum, the mast can serve as the path to ground from the lightning rod and a separate cable is not needed (the mast must still be grounded to the station ground rod, though).
9. Mark the positions of the guy wire anchors, using a jig that fits on the three tower-base leg mounts (see Figure 9 below). The jig should have a string, 6 feet, 5 inches long, attached to the center of the jig. Pull the string taut and position it so that it passes directly over the center of the tower leg to which each guy wire will be attached to mark each of the three anchor positions. Screw the guy wire anchors into the ground at the marked positions.

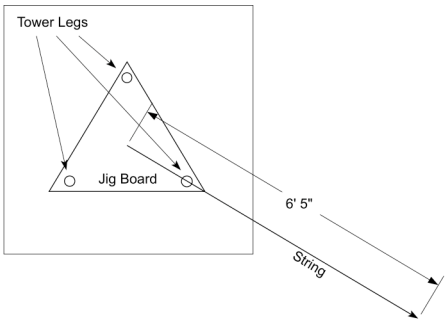

Figure 9. Diagram of a jig used to mark guy wire anchor positions for a 7-foot tower section.

10. Drive the 8-foot, copper-clad steel ground rod into the ground 1 foot due east of the southeast leg of the tower. Route the grounding cable from the lightning rod down the southeast leg of the tower and secure it to the tower.

    Note: If it is not possible to drive the 8-foot ground rod fully into the ground in rocky soil or where the bedrock is shallow, then drive additional ground rods into the ground 1 foot due west of the southwest leg of the tower, 1 foot due south of the south side of the tower, and 1 foot due north of the north leg of the tower, in that order, to achieve a cumulative length of 8 feet of rod below ground level. Drive as few ground rods as necessary to achieve the cumulative length, but no more than four rods. After driving the rods, cut off any excess so that no more than 3 inches of rod protrude above ground level. In some locations where bedrock is very shallow (i.e., where it is impossible to achieve a cumulative length near 8 feet of ground rod below ground with four rods), use a grounding plate or mesh, rather than rods.

11. Attach the tower top plate to the top of the 7-foot tower section.

12. Bolt the lightning rod to the tower top plate, in the hole closest to what will be the southeast leg of the tower. Use a copper acorn clamp to attach the grounding cable to the base of the lightning rod just above the tower top plate.

13. Bolt the hinged part of the tower base to the base plate to secure it in the upright position and bolt the tower section in place, upright on the base.

14. Install conduit between the tower and the precipitation gauge pedestal, allowing enough length to route it up the precipitation gauge pedestal to the base of the gauge and to the tower leg holding the data logger. Extend the conduit at least one foot above ground level at the tower end to prevent string trimmer or lawnmower damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.

15. Attach the guy wire cables to the tower by looping the cables around each of the three tower legs just above the second from the top rung (see Figure 10 below). Keep about 20 inches of excess cable on the shorter end of the loop. After looping each cable around the tower leg, close the loop by attaching the shorter end of the loop to the longer end using two cable clamps, the first placed 4 inches from the tower leg and the second placed 12 inches from the first.

Figure 10. Photo showing guy wire attachment to the tower

16. Attach the guy wire turnbuckles to each of the guy wire anchors, unscrewing the turnbuckles so that they are extended as far as possible. Attach the guy wire cables to the turnbuckles, looping each cable through its turnbuckle eye. Keep about 20 inches of excess cable on the shorter end of the loop. Wrap the loop around a thimble to protect the guy wire cable from being kinked by the turnbuckle eye. Attach the shorter end of the loop to the longer end using two wire clamps, the first placed as close to the thimble as possible and the second placed 12 inches from the first (Figure 11 below shows how the final product should look after the safety cables have been attached).

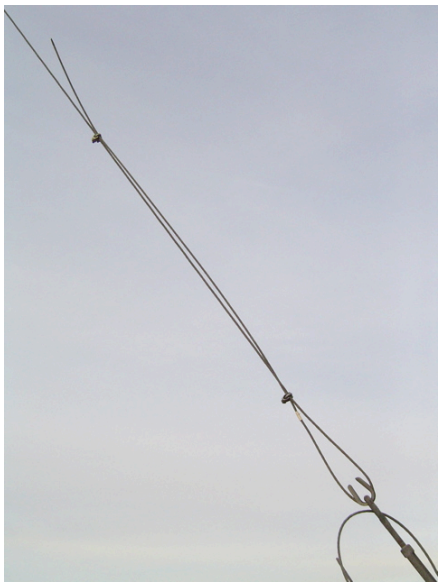

Figure 11. Photo showing guy wire attachment to the turnbuckle

17. Tighten the turnbuckles so that the tower is plumb, as checked with a level, and the guy wires are neither loose nor completely taut. There should be some slack to allow the guy wires to contract in extreme winter temperatures without pulling the tower into the ground.
18. Thread a safety cable through the center of each turnbuckle and through the eye and claw at each end of each turnbuckle. Pull the cable ends together, taking up enough slack to prevent the turnbuckle from rotating more than one turn, and clamp them together with a cable clamp.
19. Attach the radiation shields for the air temperature and relative humidity sensor(s) to the end of their mounting arm. If both are used, the shields should protrude on opposite sides of the arm. Mount the arm to the mast oriented 30° west of north, with the vertical mid-point of the shields 4 feet 11 inches (1.5 meters) above the level of the ground directly below.
20. If provided, attach the pyranometer mounting plate to the pyranometer mounting arm. Attach the arm, oriented due south, to the tower just above the attachment point for the air temperature/relative humidity arm.
21. If provided, mount the cup anemometer to the 2-meter wind arm and attach the arm to the south side of the tower, oriented to the west such that the cups are centered at 6 feet, 7 inches (2 meters) above ground level and 3 feet horizontally from the tower.
22. Attach the logger enclosure to the northwest side of the tower, placing the top of the enclosure 1 inch below the attachment point of the air temperature/relative humidity arm.

    Note: It may be easier to mount the brackets for the logger enclosure, solar panel, and battery enclosure before mounting any of the equipment to provide adequate clearance for tightening the mounting bracket screws. In addition, spacers may be required to place the equipment far enough from the tower so that it does not interfere with equipment mounted to adjacent sides of the tower.
23. Attach the solar panel to the tower, oriented due south, placing the top of the panel As high as possible on the tower. The top of the panel should be at least 7 feet above ground level so that the bottom of the panel will not obstruct airflow to the temperature, relative humidity, and dewpoint sensors. Use Table 1 on Page 7 to set the tilt angle relative to horizontal.

    Note: If the solar panel is large enough or must be placed low enough (to provide room to attach a southward-pointing communication antenna) that the bottom of the panel would be lower than the top of the temperature, relative humidity, or dewpoint sensor radiation shields, then install the panel on a separate mast 10 feet due east of the center of the tower, as explained in the Procedure for a Site with a Two-Meter Mast or Short Tower, beginning on Page 4 and shown in Figures 5 and 6 on Page 4.
24. If a separate battery enclosure is supplied, attach it to the northeast side of the tower, as high as possible, but placing the top of the enclosure no higher than the top of the logger enclosure.
25. Connect 6 AWG solid copper ground wires from the logger enclosure and from the tower (and from the solar panel mast, if applicable) to the east ground rod. Connect the east ground rod directly to each additional ground rod, if any, with 6 AWG solid copper ground wire, routing all wires at ground level to minimize tripping hazards. Use either copper or stainless steel acorn clamps for all connections.
26. Connect the grounding cable from the lightning rod to the east ground rod.

27. Attach the communication antenna at the top of the tower, oriented in the proper direction, route the antenna cable down the tower to the logger enclosure, and coil and secure any excess cable to the tower near the bottom of the logger enclosure. 2-4 feet of excess cable is OK; more than 4 feet is not acceptable.
28. If the station will be AC powered, route the power line to the base of the tower, if not already done. If visible, take a photo or photos showing where all underground AC lines are located in the plot, as explained in the Photographic Documentation of Station Installation section on Page 31. Sketch their locations in the as-built drawing.
29. Connect the battery(ies) to the regulator(s) and to the station equipment and verify that the station is powered up. If the voltage regulator(s) does not have built-in circuit breaker or fuse protection between the battery and the station, inline fuses should be installed between the battery and the station and between the battery and the GEONOR rim heater, as specified in Table 2 on Page 7. (If AC powered, a surge suppressor and a circuit breaker should be installed between the AC line and the power transformer.) Then connect the solar panel (or the output of the power transformer, if AC power is available) to the regulator and verify that the battery is being charged. Powering up the station at this point will allow verification that the sensors become operational as they are installed.
30. Connect a computer or PDA to the data logger. Download and run the appropriate program/setup for the station, if it is not already stored in the logger.
31. Install, if necessary, and configure the LETS radio, cellular modem, or GOES transmitter. Verify that the standing wave ratio of the antenna system is within the acceptable limit, if a LETS radio or GOES transmitter, following the Radio-Antenna System SWR Test procedure on Page 23.
32. Install the air temperature probe, relative humidity probe, and the pyranometer, connect them and the 2-meter anemometer to the data logger, verify that their readings reported by the logger are reasonable, and coil and secure any excess cable near the bottom of the logger enclosure. Do not coil an excessive amount of cable.
33. Install the steel screw foundation and mounting pedestal of the precipitation gauge 20 feet due east of the center of the tower and install the precipitation gauge, following the Amplified GEONOR Precipitation Gauge Installation procedure on Page 23.
34. Install the soil moisture/temperature probes, following the Amplified Soil Moisture/Temperature Sensor Installation on Page 29. Because the soil moisture/temperature probes will be connected to a multiplexer, ensure that one is installed in the logger enclosure.
35. Repair the ground over all trenches, so that the surface is smooth and is not a tripping hazard.
36. Install a fence around the perimeter of the plot, if it has been decided that it is necessary at the site. Allow for technicians and observers to easily open and latch the fence at the northwest corner.
37. If the logger enclosure is not fitted with a one-way valve that keeps moisture out and is not fitted with cable glands to seal all cable entry points, place 16 units (16 oz.) of desiccant in the logger enclosure.
38. If the logger enclosure is not fitted with cable glands, use sealing clay to seal all cable entry points.

39. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON data ingest and processing system has been established, and that data are being collected.
40. Complete all post-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 31.
41. Complete the as-built drawing, indicating variations from the standard NERON configuration.
42. Complete the station metadata form.
43. Submit the completed GEONOR calibration sheet, photos named as specified in the photographic documentation section, the completed as-built drawing, the completed station metadata form, and the completed installation checklist to the ISOS Program Office at the National Weather Service.

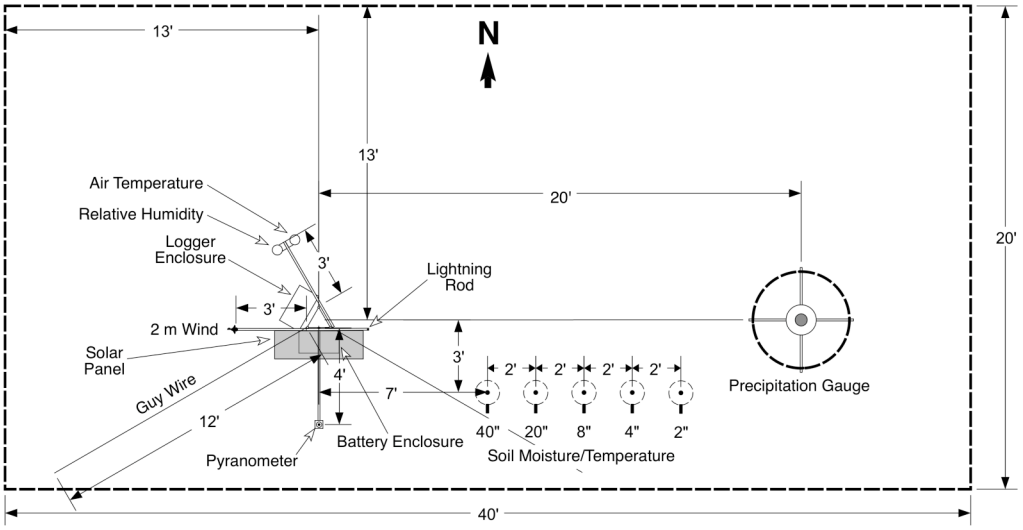

Figure 12. Plan view of a station plot that measures 20-by-40-feet and has a tall tower.

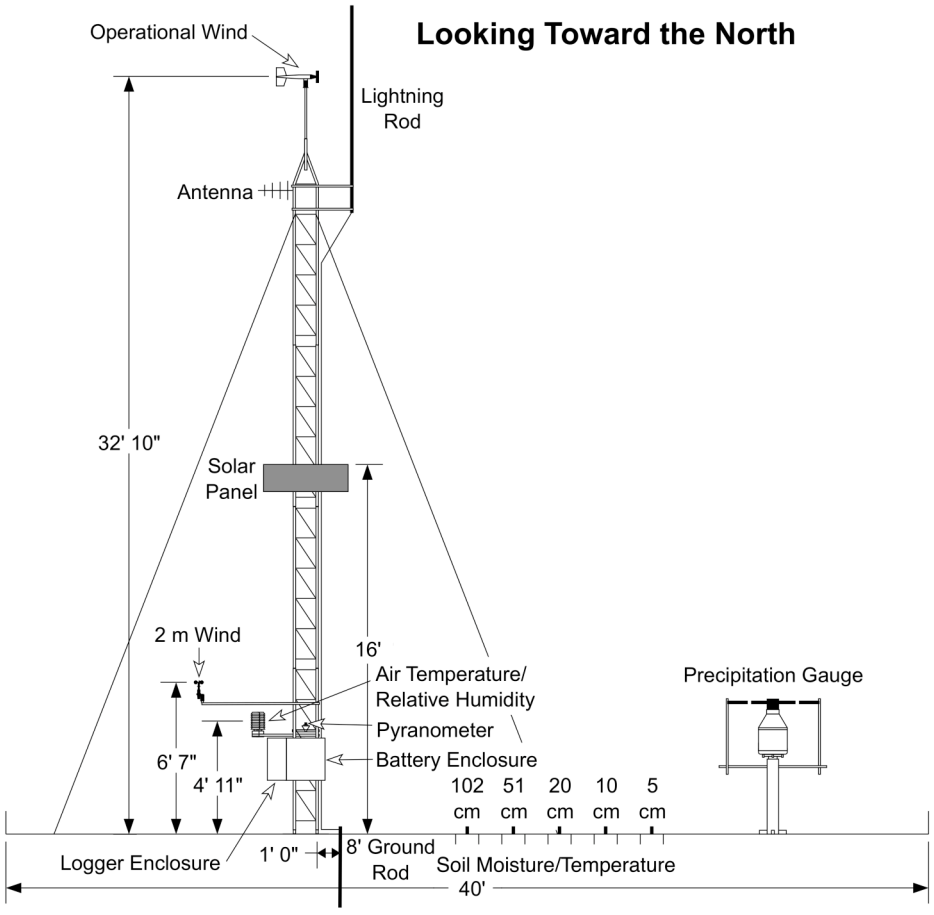

Figure 13. Profile view of a station plot that measures 20-by-40-feet and has a tall tower.

4 Procedure for a Site with a Tall Tower

Note: Refer to Figures 13 and 14 above for the positions and configuration of the equipment. In addition, these procedures cover installation for all possible sensors that could be installed at a tall tower site; not all of these sensors will be installed at every site.

Note: All compass directions referred to in these procedures are referenced to true north.

1. Obtain verification that the site is clear of underground utility lines or, if any are present, that their locations are marked and they can be avoided before digging.
2. Obtain information on the depth of the frost line if concrete foundations will be installed.
3. Complete all pre-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 31. In addition, as installation progresses, document deviations from the standard configuration and any other notable findings, as described in the photographic documentation section.
4. Measure and mark the extent of the plot, assuming the stake placed by the surveyor represents the exact center of the plot.
5. If necessary, cut the vegetation in the plot as low as possible to make installation easier; plan for its maintenance at this level.
6. Install the tower base plate with the center of the tower 13 feet east and 13 feet south of the northwest corner of the plot. The hinged side of the base plate should be to the northeast, with one of the flat tower sides facing due south (i.e., the side extends east-west). If concrete and/or special drilling or boring is required, take a photo before installing the base plate, as explained in the Photographic Documentation of Station Installation section beginning on Page 31.
7. Install the steel screw or concrete foundation for the precipitation gauge 20 feet due east of the tower, as shown in Figure 12, and when the precipitation gauge foundation is ready, install the precipitation gauge pedestal.
8. Mark the positions of the guy wire anchors, using a jig that fits on the three tower base leg mounts (see Figure 14 below). The jig should have a string, 12 feet, 5 inches long, attached to the center of the jig. Pull the string taut and position it so that it passes directly over the center of the tower leg to which each guy wire will be attached to mark each of the three anchor positions. Screw the guy wire anchors into the ground at the marked positions.

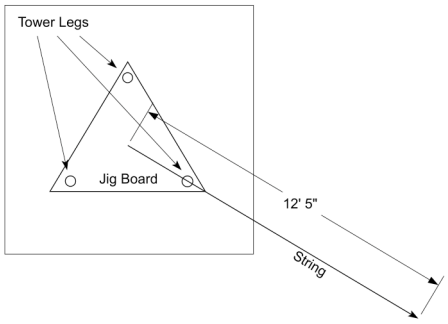

Figure 14. Diagram of a jig used to mark guy wire anchor positions for a tall tower

9. Drive the 8-foot, copper-clad steel ground rod into the ground 1 foot due east of the southeast leg of the tower.

   Note: If it is not possible to drive the 8-foot ground rod fully into the ground in rocky soil or where the bedrock is shallow, then drive additional ground rods into the ground 1 foot due west of the southwest leg of the tower, 1 foot due south of the south side of the tower, and 1 foot due north of the north leg of the tower, in that order, to achieve a cumulative length of 8 feet of rod below ground level. Drive as few ground rods as necessary to achieve the cumulative length, but no more than four rods. After driving the rods, cut off the excess so that no more than 3 inches protrude above ground level. In some locations where bedrock is very shallow (i.e., where it is impossible to achieve a cumulative length near 8 feet of ground rod below ground with four rods), use a grounding plate or mesh, rather than rods.

10. Bolt all of the tower sections together horizontally on the ground and bolt them to the base plate. Raise the top of the tower a few feet from the ground and support it in place to allow the attachment of equipment and hardware.

11. Attach the radiation shields for the air temperature and relative humidity sensor(s) to the end of their mounting arm. If both are used, the shields should protrude on opposite sides of the arm. Mount the arm to the mast oriented 30° west of north, with the vertical mid-point of the shields 4 feet 11 inches (1.5 meters) above the level of the ground directly below.

12. If provided, attach the pyranometer mounting plate to the pyranometer mounting arm. Attach the arm, oriented due south, to the tower just above the attachment point for the air temperature/relative humidity arm.

13. If provided, mount the cup anemometer to the 2-meter wind arm and attach the arm to the south side of the tower, oriented to the west such that the cups are centered at 6 feet, 7 inches (2 meters) above ground level and 3 feet horizontally from the tower.

14. Attach the logger enclosure to the northwest side of the tower, placing the top of the enclosure 1 inch below the attachment point of the air temperature/relative humidity arm.

    Note: It may be easier to mount the brackets for the logger enclosure and battery enclosure before mounting either enclosure to provide adequate clearance for tightening the mounting bracket screws. In addition, spacers may be required to place the each enclosure far enough from the tower so that it does not interfere with the other enclosure.

15. If a separate battery enclosure is supplied, attach it to the south side of the tower, placing the top of the enclosure even with the top of the logger enclosure.
16. Attach the solar panel to the south side of the tower, with its top 16 feet above ground level. Use Table 1 on Page 7 to set the tilt angle.
17. Attach the lightning rod arms to the top of the tower, against the south side of the tower, oriented to the east. Mount the rod and route the grounding cable down the southeast leg of the tower.

    Note: Mount the lightning rod high enough so that its tip is at least one foot higher than anything else mounted to the tower.
18. Attach the guy wire cables to the tower by looping the cables around each of the three tower legs just above the second from the top rung (see Figure 15 below). Keep about 20 inches of excess cable on the shorter end of the loop. After looping each cable around the tower leg, close the loop by attaching the shorter end of the loop to the longer end using two cable clamps, the first placed 4 inches from the tower leg and the second placed 12 inches from the first.

Figure 15. Photo showing guy wire attachment to the tower

19. Attach an additional winch cable for raising and lowering the tower for maintenance to the southwest leg of the tower, just above the top rung of the tapered section in the same way as the guy wires. Attach an eye or hook to the bottom end of the cable.
20. Attach the communication antenna at the top of the tower, oriented in the proper direction, route the antenna cable down the tower to the logger enclosure, and coil and secure any excess cable to the tower near the bottom of the logger enclosure.
21. If the station will be AC powered, route the power line to the base of the tower, if not already done. If visible, take a photo or photos showing where all underground AC lines are located in the plot, as explained in the Photographic Documentation of Station Installation section on Page 31. Sketch their locations in the as-built drawing.

22. Connect the battery(ies) to the regulator(s) and to the station equipment and verify that the station is powered up. If the voltage regulator(s) does not have a built-in circuit breaker or fuse protection between the battery and the station, inline fuses should be installed between the battery and the station and between the battery and the GEONOR rim heater, as specified in Table 2 on Page 7. (If AC powered, there should be a surge suppressor and a circuit breaker between the AC line and the power transformer.) Then connect the solar panel (or the output of the power transformer, if AC power is available) to the regulator and verify that the battery is being charged. Powering up the station at this point will allow verification that the sensors become operational as they are installed.
23. Connect a computer or PDA to the data logger. Download and run the appropriate program/setup for the station, if it is not already stored in the logger.
24. Install, if necessary, and configure the LETS radio, cellular modem, or GOES transmitter. Verify that the standing wave ratio of the antenna system is within the acceptable limit, if a LETS radio or GOES transmitter, following the Radio-Antenna System SWR Test procedure on Page 23.
25. Install the air temperature probe, relative humidity probe, and the pyranometer, and connect them and the 2-meter anemometer to the data logger, verify that their readings reported by the logger are reasonable, and coil and secure any excess cable near the bottom of the logger enclosure.
26. Install the operational wind prop vane on a pipe fitting inside and extending from the tapered top section of the tower. Extend the pipe from the top section to place the prop vane at 32 feet, 10 inches above ground level and secure it in place by tightening the bolt in the outer tube of the top section. Follow the Amplified Operational Wind Sensor Installation procedure on Page 26 to orient the vane's directional sensor.
27. Attach the guy wire turnbuckles to each of the guy wire anchors, unscrewing the turnbuckles so that they are extended as far as possible. Unscrew the eye completely from the southwest turnbuckle. Attach the north and southeast guy wire cables to the turnbuckles, and the southwest cable to its loose turnbuckle eye, looping each cable through its turnbuckle eye. Keep about 20 inches of excess cable on the shorter end of the loop. Wrap the loop around a thimble to protect the guy wire cable from being kinked by the turnbuckle eye. Attach the shorter end of the loop to the longer end using two wire clamps, the first placed as close to the thimble as possible and the second placed 12 inches from the first (Figure 16 below shows how the final product should look after the turnbuckle eyes have been screwed back into their turnbuckles and the safety cables have been attached).

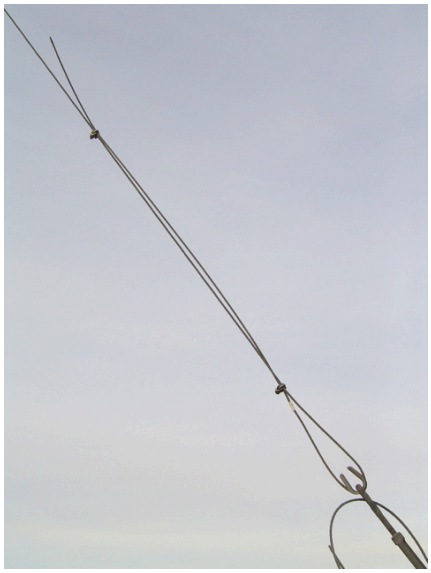

Figure 16. Photo showing guy wire attachment to the turnbuckle

28. Raise the tower with a winch connected to the winch cable and screw the turnbuckle eye of the southwest guy wire into its turnbuckle.
29. Bolt the hinged part of the tower base to the base plate to secure it in the upright position.
30. Tighten the turnbuckles so that the tower is plumb, as checked with a level, and the guy wires are neither loose nor completely taut. There should be some slack to allow the guy wires to contract in extreme winter temperatures without pulling the tower into the ground.
31. Thread a safety cable through the center of each turnbuckle and through the eye and claw at each end of each turnbuckle. Pull the cable ends together, taking up enough slack to prevent the turnbuckle from rotating more than one turn, and clamp them together with a cable clamp. Coil and secure the winch cable to the bottom of the tower.
32. Connect 6 AWG solid copper ground wires from the logger enclosure and from the mast to the east ground rod. Connect the east ground rod directly to each additional ground rod, if any, with 6 AWG solid copper ground wire, routing all wires at ground level to minimize tripping hazards. Use either copper or stainless steel acorn clamps for all connections.
33. Connect the grounding cable from the lightning rod to the east ground rod.
34. Install conduit between the mast/tower and the precipitation gauge pedestal, allowing enough length to route it up the precipitation gauge pedestal to the base of the gauge and to the tower leg holding the data logger. Extend the conduit at least one foot above ground level at the tower end to prevent string trimmer or lawnmower damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.
35. Install the precipitation gauge, following the Amplified GEONOR Precipitation Gauge Installation procedure on Page 23.
36. Install the soil moisture/temperature probes, following the Amplified Soil Moisture/Temperature Sensor Installation procedure on Page 29. Because the soil moisture/temperature probes will be connected to a multiplexer, ensure that one is installed in the logger enclosure.
37. Repair the ground over all trenches, so that the surface is smooth and is not a tripping hazard.

38. Install a fence around the perimeter of the plot, if it has been decided that it is necessary at the site. Allow enough room for technicians and observers to easily open and latch the fence at the northwest corner.
39. If the logger enclosure is not fitted with a one-way valve that keeps moisture out and is not fitted with cable glands to seal all cable entry points, place 16 units (16 oz.) of desiccant in the logger enclosure.
40. If the logger enclosure is not fitted with cable glands, then use sealing clay to seal all cable entry points.
41. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON data ingest and processing system has been established, and that data are being collected.
42. Complete all post-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 31.
43. Complete the as-built drawing, indicating variations from the standard NERON configuration.
44. Complete the station metadata form.
45. Submit the completed GEONOR calibration sheet, photos named as specified in the photographic documentation section, the completed as-built drawing, the completed station metadata form, and the completed installation checklist to the ISOS Program Office at the National Weather Service.

5 Radio-Antenna System SWR Test

Use an RF power meter placed between the transmitter and the antenna cable at sites with GOES or LETS radios. Verify that the meter is rated or set for the frequency range of the transmitter. Table 3 below lists forward power (W_f) values and the corresponding reflected power (W_r) values for standing wave ratios (SWR) of 1.5:1, 2:1, and 3:1. For optimum communication quality, the SWR should be less than 1.5:1, though a value less than 2:1 is acceptable. If the SWR is 2:1 or greater but less than 3:1, a problem exists that should be fixed soon, though the radio can continue to operate. If the SWR is 3:1 or greater, then the radio can be damaged and should be immediately turned off, and left off until the problem is fixed.

Table 3. Forward power (W_f) and corresponding reflected power (W_r) values for standing wave ratios of 1.5:1, 2:1, and 3:1 for radio-antenna systems.

W_f (W)	W_r 1.5:1 SWR (W)	W_r 2:1 SWR (W)	W_r 3:1 SWR (W)
10.0	0.40	1.11	2.50
9.0	0.36	1.00	2.25
8.0	0.32	0.89	2.00
7.0	0.28	0.78	1.75
6.0	0.24	0.67	1.50
5.0	0.20	0.56	1.25
4.0	0.16	0.44	1.00
3.0	0.12	0.33	0.75
2.0	0.08	0.22	0.50
1.5	0.06	0.17	0.38
1.0	0.04	0.11	0.25
0.8	0.03	0.09	0.20
0.6	0.02	0.07	0.15
0.4	0.02	0.04	0.10
0.2	0.01	0.02	0.05

Check all of the coaxial cable connectors for security, damage, corrosion, or bent center pins; check the antenna for damage; and check the entire length of coaxial cable for wear, damage, or cuts. Any of these conditions could attenuate RF signal power at the antenna and/or reflect power toward the transmitter, which would increase the standing wave ratio and further reduce transmission power. Replace or repair damaged components. In addition, if the SWR is too high, check that there are no nearby metal objects above, below, or to either side of the antenna.

6 Amplified GEONOR Precipitation Gauge Installation

(Adapted from GEONOR Users Manual for Precipitation Gauge T-200)

1. Separate the housing from the precipitation gauge. Release the three toggle clamps on the sides of the gauge toward the bottom and lift the housing from the base.
2. Attach the base to the pedestal using three M8 bolts. Level the base using a bubble level by adjusting the three hexagonal adjusting screws under the base. Carefully tighten the M8 screws without disturbing the level of the gauge.
3. Slide the cable gland onto the precipitation gauge cable and feed the precipitation gauge cable through the threaded hole in the bottom of the gauge. Screw the cable gland into the hole and tighten the gland screw snugly against the cable. Connect the leads to the three vibrating wire terminal boxes or to the terminal strip attached to the upper flange of the gauge base, as applicable. It is important to connect the three positive vibrating wire cable leads (white, gray, and brown) to the terminals/boxes corresponding to the correct vibrating wire sensors so that the correct calibration coefficients will be applied. The northeast vibrating wire sensor is designated #1 (VW1), the south sensor is #2 (VW2), and the northwest sensor is #3 (VW3). Use Table 4 below as a guide in connecting the leads, noting that the wire colors differ for Vaisala- and Campbell-based stations.

   Note: The VW1 *terminal box* may actually be the north or northwest terminal box. The numbering of the sensors is based solely on the locations of the sensors, not their terminal boxes.

Table 4. Wiring of the precipitation gauge to the precipitation cable.

Terminal	Wire Color Vaisala	Wire Color Campbell
VW1 VWG+ (Terminal 5)	Brown	Violet
VW2 VWG+ (Terminal 5)	White	White
VW3 VWG+ (Terminal 5)	Gray	Yellow
VWG- of all three sensors (Terminal 3)	Green/Yellow	Black
Ground of any one sensor (Terminal 1)	Black (shield)	N/A

4. Place the aluminum bucket support dish in the bottom of the base.
5. Attach the three vibrating wire sensor assemblies to the upper flange of the gauge body. They are suspended by adjustment screws placed in square holes. Verify that the vibrating wire sensors slide freely in the square holes, and enlarge the holes with a file if they do not.
6. Secure the aluminum support dish to the vibrating wire sensors with the S-hooks hanging from the sensors.
7. Secure the cables attached to the tops of the sensor assemblies to the gauge base using plastic cable ties or adhesive cable tape. Route the cables so that they do not come into contact with the suspended parts and ensure that the bend radii are sufficiently large to avoid undesirable mechanical stress being transmitted to the sensor assemblies.
8. Wire each sensor cable to its terminal box: orange to Out + (Terminal 6) and blue to Out – (Terminal 4).

9. Verify that the aluminum support dish is hanging freely and secure any cables that come into contact with it.
10. Insert the bucket, aligning the dot on the bucket with the dot placed on the upper flange of the gauge next to one of the vibrating wire sensor suspension holes. This ensures correct calibration if the bucket is removed and replaced. If there is not a dot on the upper flange, make a clear and permanent mark on it.
11. Place the level on the rim of the bucket and level it by adjusting the three black knurled nuts on the upper flange from which the vibrating wire sensors are suspended. Take cross readings with the level to ensure proper level in two dimensions. These readings ensure that the three assemblies carry identical loads, maximizing accuracy.
12. Verify that the bucket does not come into contact with the cable in the base of the gauge. Raise all three vibrating wire sensors with their adjusting nuts, if necessary.
13. To release the vibrating wire assembly from its transport position, remove the red tape and unscrew the black screw on the lower part of each vibrating wire sensor.
14. Connect the long rim heater cable to the leads from the heater using a weatherproof connector at the level of the base of the gauge.
15. Feed the precipitation gauge and rim heater cables through the conduit.
16. Secure the conduit to the precipitation gauge pedestal and to the mast or tower at the other end. Coil and secure any excess cable to the mast/tower near the bottom of the logger enclosure. Do not store an excess of cable. Plug the conduit ends with sealant to prevent moisture and insects from entering the conduit.
17. Connect the cable to the data logger, verify that the three vibrating wires are vibrating audibly, and verify that the precipitation values reported by the logger are reasonable.
18. If a Vaisala-based station, connect the rim heater cable to the MINCO heater control module, using Table 5 below as a guide.

Table 5. Wiring of the precipitation gauge heater control module for a Vaisala-based station.

Terminal	Wire Color
Terminal 3 (Heater)	Red and White
Terminal 4 (Heater)	Two Black wires paired with the Red and White leads
Terminal 5 (Sensor)	Green
Terminal 6 (Sensor COM)	Black that is paired with the Green lead
Terminal 7 (Sensor COM)	Jumper from Terminal 6

19. If a Vaisala-based station, connect the MINCO heater control module to the logger-controlled power relay. Skip to Step 21.

If a Campbell-based station, connect the heater wires as indicated in
20. Table 6 below.

Table 6. Logger enclosure wiring of the precipitation gauge heater for at a Campbell-based station.

Terminal	Wire Color
NO on ATDD relay	Red
E3 on CR10X	Orange
2L on CR10X	Brown
H on negative battery terminal	Black

21. Calibrate the precipitation gauge, following the procedure listed on Page 26.
22. Tighten the black transport screws at the bottom of each vibrating wire sensor to protect the wires from breaking as antifreeze and/or oil is added to the bucket.
23. Add the necessary mixture of antifreeze and oil for the station location, according to the guidelines in the Site Maintenance document.
24. Loosen and remove the transport set screw from each vibrating wire sensor and place it in the bottom of the base.
25. Replace the gauge housing and secure it with the toggle clamps.
26. Measure and place a line on each of the four horizontal Alter shield-mounting tubes 19 11/16 inches from the threaded end.
27. Screw the horizontal tubes into the gauge pedestal.
28. Slide the Kee clamps onto the horizontal tubes until their inside edges touch the marks. Align their vertical holes on the counter-clockwise side of each horizontal tube as seen from the sky and tighten them.
29. Place the vertical tubes in the Kee clamps with the notched and threaded ends up, pushing them into the clamps until their stop pins contact the clamps. Tighten the clamps.
30. Join the four Alter shield sections together so that they form a closed ring with their blade channels pointing away from the center and tighten the allen screws.
31. Carefully place the ring into the four slots in the vertical tubes at the points between the shield elements that do not have spacers.
32. Screw the four 1-inch tube caps and tighten them so that the caps grip the ring.
33. Make final adjustments, ensuring that the upper ends of the windshield blades are ½ inch higher than the top of the gauge inlet, and retighten all screws.

7 GEONOR Precipitation Gauge Calibration

(From NOAA/ATDD & NCDC Climate Reference Network Documentation Manual)

Equipment

- 11 Troemer-certified machined brass 1000g calibration weights and an aluminum base/centering weight

- Computer with MS Excel

Test Method

The GEONOR Rain Gauge has a fill capacity of 12 liters (12.72 quarts). At 4°C, one liter of water weighs 1000g. The machined weights weigh 1000.0g ±0.1g and represent one liter of water. The known weights are added to the gauge and the output is recorded. From these values, calibration curves are developed using Excel's linear regression feature.

Test Procedure

1. Record all precipitation gauge serial numbers on the GEONOR precipitation gauge calibration sheet.
2. After the rain gauge has been properly installed and leveled at the test site, record the initial output. Carefully add the aluminum base/centering weight to the bucket, wait two minutes, and record the frequencies of the individual sensors. Carefully add the first brass weight, wait two minutes and record the frequency. Repeat ten more times to reach the maximum gauge capacity.

   Note: The weights should be added slowly and carefully to avoid breaking any of the vibrating wires.
3. Enter the values into the special GEONOR Rain Gauge Calibration Program, shown in Figure 17, to perform a second-order linear regression analysis to determine the equation to relate frequency to rainfall depth (Depth (mm) vs. F-Fo).
4. Enter the coefficients into the data logger's static parameters.

GEONOR CALIBRATION PROGRAM

SERIAL NUMBER= 12800 DATE = 10/17/2001

STATION: ID - LOCATION = NC-ARBORETUM

VOLUME (mL)		DEPTH (cm)		FREQ. (F) (Hz)		F - F0 (Hz)
0		0		1053.4	(= F0)	0
1000		5		1310.9		257.5
2000		10		1523		469.6
3000		15		1705.4		652
4000		20		1868.9		815.5
5000		25		2017.9		964.5
6000		30		2155.5		1102.1
7000		35		2284.1		1230.7
8000		40		2405.3		1351.9
9000		45		2520.9		1467.5
10000		50		2629.5		1576.1
11000		55		2734.5		1681.1
12000		60		2833.8		1780.4

EQUATION : DEPTH = A(F - F0) + B(F -F0) ^{2}

A = x coef., B = x^2 coef. and (F - F0) = x

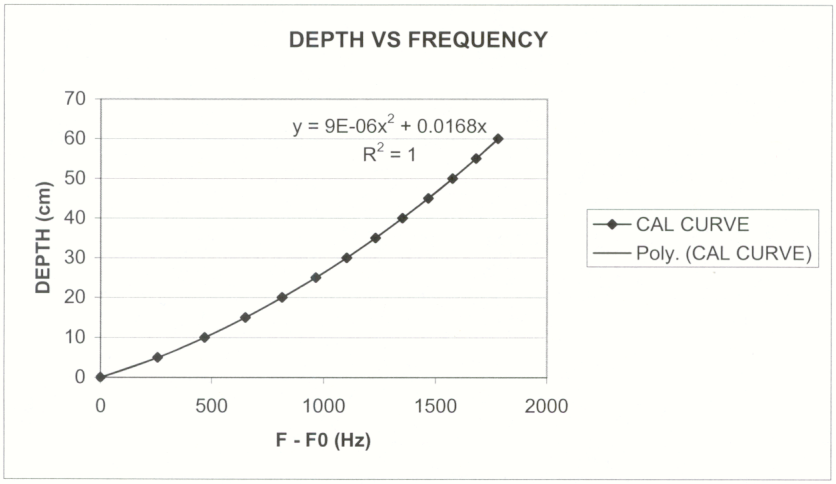

Figure 17. Sample input to and resulting calibration curve from the GEONOR precipitation gauge calibration program.

8 Amplified Operational Wind Sensor Installation

(TO BE INSERTED)

9 Amplified Soil Moisture/Temperature Sensor Installation

Note: The soil moisture/temperature probe should be handled carefully to avoid bending the tines or nicking or scratching the sensor head from which the tines protrude. Bending the tines will cause erroneous readings, since they must be at a set distance from each other to obtain accurate soil capacitance and inductance readings. Deep nicks or scratches in the sensor head could expose the electronics to moisture, permanently damaging the sensor.

1. Locate and mark the hole locations at the positions shown in Figures 1, 3, 5, 7, and 13 and in Table 7 below.

Table 7. Soil moisture/temperature probe installation hole locations relative to the center of the mast or tower.

	10x16 plot		16x20 plot		20x40 plot	
Sensor Depth (in.)	**Position E-W (ft)**	**Position N-S (ft)**	**Position E-W (ft)**	**Position N-S (ft)**	**Position E-W (ft)**	**Position N-S (ft)**
2	11 E	3 S	11 E	6 S	15 E	3 S
4	9 E	3 S	9 E	6 S	13 E	3 S
8	7 E	3 S	7 E	6 S	11 E	3 S
20	5 E	3 S	5 E	6 S	9 E	3 S
40	3 E	3 S	3 E	6 S	7 E	3 S

2. Remove and set aside a 10-inch diameter sod plug for each hole, being careful to keep the sod as intact as possible to recover the hole when installation is complete.
3. Excavate the hole to a depth 10 inches greater than the sensor depth. This will provide a collection area below the actual sensor for any water that seeps down the inner surface of the hole. Use a gas-powered auger (10-inch diameter) for 20- and 40-inch sensors. Post hole diggers may be used for 2-, 4-, and 8-inch sensors. Collect the excavated soil on a tarp, preserving the order of removal so that the soil stratification can be restored as much as possible when refilling the hole.
4. Take an approximately 4-cubic-inch soil sample at the sensor depth from the west, east, and/or north sides of the hole and place it in a plastic zipper-seal bag; label the station, depth, and date on the bag. Submit it to (TO BE INSERTED) for analysis.

5. Install conduit extending from the tower to just below sensor depth at the north side of the installation hole. Extend the conduit at least one foot above ground level at the tower end to prevent string trimmer or lawnmower damage to the cables. For 2-inch, 4-inch, and 8-inch sensors, cut and install a length of wire braid material to extend from the sensor to a few inches inside the end of the conduit to discourage burrowing animals from chewing through the cable. Feed the sensor cable through the conduit and push the metal braid a few inches into the conduit. Bury the conduit so that its top is at or below ground level, to allow a mower to pass over it.
6. Use a putty knife or paint scraper to smooth out the vertical surface on the south side of the hole at the sensor depth and to make it as vertical as possible.
7. Use a measuring stick and a straight edge placed horizontally at ground level at the top of the hole to determine the exact depth at which to install the sensor.
8. Insert the sensor horizontally into the soil, pointing south, at the proper depth. Do not move the sensor from side-to-side or wiggle it as it is inserted, as this could bend the tines and will form air pockets that will cause erroneous readings. In hard or rocky soils, use the Hydra Probe Jig to make pilot holes for the tines.
9. Route the sensor cable so that a drip loop is formed below the sensor.

Figure 18. Vertical cross-section showing hole dimensions and conduit, cable, and sensor placement. (TO BE INSERTED)

12. Wire the sensor to the data logger and perform a soil moisture cycle to check its operation. Initiate the cycle by entering (TO BE INSERTED) via the keypad. The cycle will occur during the next complete (TO BE INSERTED) second execution interval.
13. Backfill the installation hole with excavated soil in reverse of the order it was removed to preserve the soil stratification, making sure to tamp the soil well. Add water to help the soil settle.
14. Place a plot marker 12 inches due north of the hole center and mark the depth of the sensor on the top of the marker with a paint pen.
15. Replace the sod plug and repair the cut between the sod plug and the surrounding soil.

10 Photographic Documentation of Station Installation

Photos should be taken with a digital camera set at its highest picture quality setting. The submitted photos should be JPEG format and at least 2048 x 1536 pixels (3.2 megapixels) in size. All photos should be taken in landscape, rather than portrait, orientation. If possible, set the camera to stamp the current date in the bottom corner of each photo. The photos should be taken with enough ambient light to clearly see the subjects of interest. Avoid taking photos after sunset, before sunrise and at night. Any vehicles or equipment used during installation shall be moved so that they do not appear in any of the photos, and there shall be no people in the photos. Name the photos according to the following convention:

STNIDYYYYMMDDX#.jpg

where

STNID = the 3- or 5-character station ID
YYYY = year
MM = month
DD = day of the month
X = the code given in bold type for each photo in the list below
# = number the photos if multiple views are photographed for a single item.

Note: All compass directions referred to are referenced to true north.

Before Installation

1. Photos from a level tripod at the center of the plot to the eight points of the compass:
   0° = **N_**
   45° = **NE**
   90° = **E_**
   135° = **SE**
   180° = **S_**
   225° = **SW**
   270° = **W_**
   315° = **NW**

   Note: If these photos must be taken after installation is complete (e.g., due to poor lighting conditions), the camera shall be positioned such that none of the station equipment appears in any of the above photos.
2. Photo of GPS display, showing the reading taken at the center of the site plot: **GPS**

During Installation

1. Photo(s) of the tower/mast/precipitation anchor/foundation hole, before the anchoring equipment has been installed, if concrete and/or special drilling or boring is required:
   tower = **HTF**
   mast = **HMF**
   precipitation = **HPF**

2. Photo showing the location of the trench for buried AC power cables, if installed = **ACT**
3. Photo of each soil moisture sensor, installed in its hole, showing the entire hole, before the hole is filled:
   5 cm = **HSM005**
   10 cm = **HSM010**
   20 cm = **HSM020**
   51 cm = **HSM051**
   102 cm = **HSM102**
4. Document deviations from the standard configuration and any other notable findings, appending logical codes of no more than 5 characters. Explain what they show in the site metadata form, referring to them by code.

When Installation is Complete

1. 4 photos taken looking toward the station, standing far enough from the station for the entire plot and tower or mast to fit in the frame, *from* the following directions:
   due north = **IN**
   due east = **IE**
   due south = **IS**
   due west = **IW**
2. A "cover" shot of the station for the official archive, taken from the south. It should show the entire plot and the tower or mast with a margin of sky at the top. In many cases the **IS** photo meets these requirements; if so, simply make a copy with the appropriate name: **CS**. However, take this photo with the camera in portrait orientation at a station with a tall tower
3. Photo(s) of the tower/mast/precipitation anchor/foundation, if special drilling, boring, or concrete were required:
   tower = **TF**
   mast = **MF**
   precipitation = **PF**
4. Photo from a position 2 feet north of each soil moisture marker, showing the filled and repaired hole with its marker and the 2-foot-by-2-foot plot centered over the sensor:
   5 cm = **SM005**
   10 cm = **SM010**
   20 cm = **SM020**
   51 cm = **SM051**
   102 cm = **SM102**

Example:

The following example indicates the proper naming of photos for Andover, ME (ANDM1), which has a mast, rather than a tower, installed on October 20, 2004, assuming it has AC power, soil moisture sensors, and required special drilling, boring, or concrete to install the mast and precipitation gauge foundations:

ANDM120041020N_.jpg – view to the north
ANDM120041020NE.jpg – view to the northeast
ANDM120041020E_.jpg – view to the east

ANDM120041020SE.jpg – view to the southeast
ANDM120041020S_.jpg – view to the south
ANDM120041020SW.jpg – view to the southwest
ANDM120041020W_.jpg – view to the west
ANDM120041020NW.jpg – view to the northwest

ANDM120041020HMF1.jpg – photo of mast foundation hole #1
ANDM120041020HMF2.jpg – photo of mast foundation hole #2
ANDM120041020HPF.jpg – photo of precipitation gauge foundation hole
ANDM120041020ACT.jpg – photo of buried AC power cable trench
ANDM120041020HSM005.jpg – photo of 5-cm soil moisture sensor in its hole
ANDM120041020HSM010.jpg – photo of 10-cm soil moisture sensor in its hole
ANDM120041020HSM020.jpg – photo of 20-cm soil moisture sensor in its hole
ANDM120041020HSM051.jpg – photo of 51-cm soil moisture sensor in its hole
ANDM120041020HSM102.jpg – photo of 102-cm soil moisture sensor in its hole
ANDM120041020GNDRD.jpg – additional photo showing non-standard configuration of ground rod(s), with maintainer-chosen logical code

ANDM120041020IN.jpg – photo from the north of the installed station
ANDM120041020IE.jpg – photo from the east of the installed station
ANDM120041020IS.jpg – photo from the south of the installed station
ANDM120041020IW.jpg – photo from the west of the installed station
ANDM120041020CS.jpg – cover shot of the installed station, taken from the south
ANDM120041020MF.jpg – photo of the completed mast foundation
ANDM120041020PF.jpg – photo of the completed precipitation gauge foundation
ANDM120041020SM005.jpg – photo of the completed 5-cm soil moisture sensor plot
ANDM120041020SM010.jpg – photo of the completed 10-cm soil moisture sensor plot
ANDM120041020SM020.jpg – photo of the completed 20-cm soil moisture sensor plot
ANDM120041020SM051.jpg – photo of the completed 51-cm soil moisture sensor plot
ANDM120041020SM102.jpg – photo of the completed 102-cm soil moisture sensor plot

11 Serial Number Labeling of Sensors and Equipment

All sensors and all equipment listed in the NERON Station Metadata Form must have serial numbers assigned to them before they are installed so that they can be tracked accurately in the metadata database. However, if a sensor or unit of equipment is encountered in the field that does not have a serial number, the following convention should be used for assigning serial numbers to all equipment that do not have manufacturer-assigned serial numbers:

TTTYYDDD###

where,

TTT = sub-type of equipment (see). Do not use unless shows an entry for the equipment type. Use leading zeros if the sub-type is less than 3 digits.
YY = last two digits of year that the number was assigned
DDD = Julian day that the number was assigned
= number in the series of the specific kind of sensor or equipment. Use leading zeros if the number is less than 3 digits

The ### part allows the assignment of serial numbers to multiple units of the same equipment or sensor type at the same time. Simply use 001 for the first, 002 for the second, etc. One sensor type or equipment type can have the same serial number as a different type of sensor or equipment, since each unit of equipment is always referred to in the metadata database by both its equipment type and serial number. The only requirement is that sensors or equipment of the same type have unique numbers. Equipment with different sub-types are considered different types and can be assigned identical YYDDD### portions of their serial numbers.

Table 8. Entries to use for the equipment sub-type portion when assigning a serial number to a sensor or unit of equipment.

Equipment Type	TTT
Solar Panel	Rating in watts
Battery	Amp-hour rating

Every sensor, except for barometers, should be labeled such that its serial number is printed on the cable end that is connected to the logger. The serial number should be printed on light-colored heat-shrink tubing, with an additional layer of clear heat-shrink tubing over the serial numbers to prevent them from being rubbed off or obscured. Sub-surface sensors that do not have their serial numbers stamped or etched on the sensor heads should have an additional label at the sensor end of the cable.

Every sensor or unit of equipment that is not installed inside an enclosure should have its serial number etched on its body, if possible. If the serial number is just printed on the body by the manufacturer or the manufacturer did not assign a serial number, then the installer should etch the serial number on an available non-sensitive surface. If etching is not possible, then the serial number should be printed on the cable, as described above. This will prevent problems with tracking sensors and equipment whose serial numbers have become unreadable due to weathering.

Examples:
The following examples indicate the proper assignment of serial numbers to equipment, when assigned on June 7, 2005 (Julian day 158):

First 84 amp-hour battery of the day to be numbered – 08405158001
First 26 amp-hour battery of the day to be numbered – 02605158001
First 50W solar panel of the day to be numbered – 05005158001
Second 50W solar panel of the day to be numbered – 05005158002
First air temperature sensor of the day to be numbered – 05158001
Second air temperature sensor of the day to be numbered – 05158002
First precipitation gauge base of the day to be numbered – 05158001

12 Use of the Metadata Form

The metadata form should be used to report initial installations and moves of stations, as well as any changes in station metadata beyond maintenance and equipment changes accounted for in the maintenance and trouble ticket forms.

The following is an explanation of how to enter information in all sections of the metadata form.

12.1 Header

The header should be filled out completely any time the metadata form is used. If an update, enter only the information that has changed in the sections after the header.

- Check the "Initial Installation" box if this is the first time the station is being installed. Check the "Move" box if an existing station is being moved to a new location nearby. Check the "Update" box if metadata is being updated for an existing station that is not being moved. When moving a site, use the Weather Reference Network Trouble-Ticket Form for Mass Installs, Fixes, or Moves to document the serial numbers of all equipment removed. Then use the metadata form to document all equipment installed at the new location.
- Enter the 5-character station ID, the full station name, and circle the station type (REMO for a remote weather station, RPTR for a communication repeater, or BASE for a communication base station).
- Enter the effective date and time of the change in coordinated universal time (UTC). In the case of an installation or move, this is the time that the installation or move is totally complete and the station has been verified operational.

12.2 Site Information

- Enter the latitude and longitude, as measured from the center of the site plot, using a GPS receiver with Wide-Area Augmentation System (WAAS) or differential capability, *in fractional degrees to 5 decimal places*. Enter the elevation, as measured by the same GPS receiver. Take a photo of the GPS display, formatted as described in the Photographic Documentation of Station Installation section on Page 31.
- Enter the manufacturer and model number of the GPS used to determine latitude and longitude in the "LAT/LON SOURCE" box and the manufacturer and model number of the device used to determine the elevation in the "ELEV SOURCE" box. If a single GPS receiver is used for both lat/lon and elevation, enter the same information in both boxes. Enter the horizontal and vertical coordinate reference datums used by the GPS. The horizontal reference datum used must be NAD83 (North American Datum of 1983) or later, and the vertical reference datum used must be NAVD88 (North American Vertical Datum of 1988) or later. It is important to note the datum used, because errors of up to 150 feet can be introduced by assuming the wrong datum.
- Enter the offset of local standard time from Coordinated Universal Time (UTC), the magnetic declination (the number of degrees that a compass needle points east or west of true north; be sure to include "W" or "E," as appropriate, after the number).

- Enter the state, county, climate division, the three-letter ID of the weather forecast office (WFO) in whose county warning area (CWA) the site is located, and the government property ID (if applicable).
- Circle the plot size, indicate whether a fence is installed around the perimeter of the plot, describe the type of fence, indicate whether the station is solar- or AC-powered, whether an enclosure heater is installed, and enter the number of ground rods, ground plates, and/or grounding mesh matrices installed.

12.3 Basic Sensors Installed

- Enter the manufacturer, model number, and serial numbers of the air temperature sensor, and the precipitation gauge base (the frame holding the vibrating wire sensors). In addition, enter the serial numbers of the precipitation gauge bucket and vibrating wire sensors, if a GEONOR T-200 gauge. Enter "N/A" in the manufacturer field of all sensors that are not installed, for initial installations and moves.
- Enter the calibration coefficients of each vibrating wire sensor, if a GEONOR T-200 gauge.
- Circle the precipitation gauge type, enter the height of the gauge inlet, indicate whether a precipitation gauge heater is installed, and enter the manufacturer and model number of the heater.
- Enter the types of antifreeze and oil initially put in the gauge, and enter the amount of antifreeze added. This applies only to weighing-bucket-type gauges. (It is not necessary to submit a new metadata form if the antifreeze type or amount or the oil type changes.)

12.4 Enhanced Sensors Installed

Enter the manufacturer, model number, and serial number of each enhanced sensor installed. See Table 9 below for an explanation of the sensor parameter IDs. Enter "N/A" in the manufacturer field of all sensors that are not installed, for initial installations and moves.

Table 9. Equipment IDs used in the metadata form.

Equipment ID	Explanation
LOGG	Data logger
WIRPAN	Data logger wiring panel (Used only for Campbell CR10X)
PRTMOD	Module add-on to expand data logger ports
MUX	Multiplexer
RADIO	Primary data communication radio (LETS, CELL, or GOES)
RFMODM	RF modem, if a separate unit from the radio
RS232IF	RS-232 interface (required to interface RS-232 devices with Campbell CS I/O port)
SERSRV	Serial server (base station equipment)
ETHHUB	Ethernet hub or switch (base station equipment)
ROUTER	Ethernet router (base station equipment)
SERADS	Wireless serial radio installed at the station for communication with the site host's PDA

Equipment ID	Explanation
SERADH	Wireless serial radio installed at the location of the site host's PDA
PDA	PDA used by the site host to communicate with the station
SOLRP	Primary solar panel; connected to the battery(ies) that are connected directly to the data logger and are isolated from the precipitation gauge heater
SOLRPS	Secondary solar panel; connected to the battery(ies) that are connected directly to the precipitation gauge heater and are isolated from the data logger
ACTRAN	AC 120V to DC ~15V transformer installed at AC-powered sites
SRGSUP	Surge suppressor installed on the AC line at AC-powered sites
TPS	Telnet or internet power switch (base station equipment)
VREG	Primary voltage regulator; connected to the battery(ies) that are connected directly to the data logger and are isolated from the precipitation gauge heater
VREGS	Secondary voltage regulator; connected to the battery(ies) that are connected directly to the precipitation gauge heater and are isolated from the data logger
BATCHG	AC-powered battery charger
BATV	Primary battery(ies); connected directly to the data logger and isolated from the precipitation gauge heater
BATVS	Secondary battery(ies); connected directly to the precipitation gauge heater and isolated from the data logger
TAIR	1.5 meter air temperature sensor
PRECIP	Refers specifically to the precipitation gauge base, which holds the vibrating wire sensors and the bucket; does not include the gauge top. Parameter ID refers to accumulation data integrated from all three vibrating wire sensors by the logger's internal algorithm.
BUCKET	The precipitation gauge bucket
VWPCP1	Precipitation level indicated by precipitation gauge vibrating wire 1, the first sensor clockwise from true north on the precipitation gauge as viewed from above
VWPCP2	Precipitation level indicated by precipitation gauge vibrating wire 2, the second sensor clockwise from true north on the precipitation gauge as viewed from above
VWPCP3	Precipitation level indicated by precipitation gauge vibrating wire 3, the third sensor clockwise from true north on the precipitation gauge as viewed from above
WS2M	2 meter wind speed sensor
WSPD	Operational wind speed sensor
WDIR	Operational wind direction sensor
PRES	Barometric pressure sensor
SRAD	Solar radiation sensor
IRTT	Infrared skin temperature sensor
RELH	Relative humidity sensor with optional secondary air temperature sensor
DEWPNT	Dewpoint sensor
WTRVAP	Water vapor detection sensor
FW005, TS005	5-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under vegetation
FW010, TS010	10-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under vegetation

Equipment ID	Explanation
FW020, TS020	20-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under vegetation
FW051, TS051	51-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under sod
FW102, TS102	102-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under sod

12.5 Equipment Installed

Enter the manufacturer, model number, and serial number of each unit of equipment installed. See Table 9 above for an explanation of the Equipment parameter IDs. Enter "N/A" in the manufacturer field of all equipment that is not installed, for initial installations and moves.

- LOGG. In addition, enter the logger operating system or firmware version, the program or setup name (if this file is given a unique name for each site before it is uploaded to the data logger, record the general name of the program or setup before it is renamed), and the version number of the program or setup.
- RADIO. In addition, circle the type of radio and enter the information appropriate to that radio type, enter the antenna height above ground level in feet, circle the type of the antenna installed, the number of elements (if a yagi antenna is used), the true azimuth toward which the antenna is oriented, and the inclination relative to horizontal of the antenna if a GOES system.
    - LETS. Enter the frequency (or band of frequencies, in the case of a spread spectrum radio) at which the radio operates in MHz, the RF ID assigned to the station, and the ID of the station's RF subnet, if applicable.
    - CELL. Enter the service provider's name, the modem's electronic serial number (ESN or EIN), the mobile directory number (MDN), the mobile identification number (MIN or MSID; this is the modem's phone number), the IP address (if static; if dynamic, then enter "dynamic"), the network access ID, the system ID (SID), the network ID (NID), and the frequency band in MHz.
    - GOES. Enter the NESDIS ID, the baud rate, the channel indicated on the NESDIS assignment sheet in the "GOES NESDIS CHANNEL" box, the channel actually entered in the transmitter configuration (which is roughly half the value of the NESDIS channel for many transmitters for 1200 baud channels) in the "GOES TXER CHANNEL" box, the transmit time of the first transmission of the day in seconds past midnight UTC (the number shown on the NESDIS assignment sheet is given in minutes and seconds and must be converted to seconds), the transmit window in seconds, and the interval between transmissions in seconds.
- SOLRP and SOLRPS. In addition, enter the inclination of each solar panel (the direction the face of the panel is oriented) relative to horizontal.

12.6 Site Access

- Check the "Yes" box if National Weather Service and National Weather Service contractors will have unrestricted access to the site at all times, if "No", explain all restrictions in the text box.

- If there will be a locked gate or door controlling access to the station, circle "Y" in the "Locked Gate?" box, "N" otherwise. If the site host will allow NWS to daisy chain its own lock at the gate or door, circle "Y" in the "NWS Lock Allowed?" box, "N" otherwise. If an NWS lock has actually been installed at the gate or door, check "Y" in the "NWS Lock Installed?" box, "N" otherwise. If there is a non-NWS key lock, enter the number of keys acquired for NWS and NWS contractor use. If there is a gate or door with a key lock, NWS or not, enter the key number or ID. If there is a combination lock, enter the combination.
- Indicate whether the LETS agencies will require identification to enter any of their premises (e.g., local PD, state highway patrol office, etc.)
- Indicate whether 2-wheel-drive vehicles and 4-wheel-drive vehicles will be able to drive to the site throughout the year, and if not, explain why not and when access will or will not be possible in the text box for both 2WD and 4WD.
- Indicate whether the site host prefers not to have vehicles driven off-road under any conditions or has any restrictions on the route driven to the site, and explain all preferences and restrictions in detail.

12.7 Site Driving Directions

Describe how to drive to the site from a nearby intersection of two US/state highways or from an interstate highway exit. Include the distance driven to each turning or end point in tenths of a mile.

12.8 Site Host Special Instructions

Indicate how the site host prefers that maintainers dispose of grass cuttings from the site plot and describe any other special instructions that the site host has for anyone who might visit the station.

12.9 Site Contact Info

Enter as much of the contact information as possible, so that the site host can be contacted easily.

12.10 Notes

Take notes of any pertinent information that is not covered elsewhere in the form, which would have an effect on sensor exposure, station operation, or anyone visiting the site.

12.11 Obstructions

Use a rangefinder and compass to measure the range and direction to each obstruction within 330 feet (100 meters) of the center of the site plot. Draw each obstruction in its location relative to the station within the circle, using the azimuth lines and the circle edge (which indicates the 330-foot range from the center of the plot) as a guide. Label the true bearing from the center of the plot, the estimated or measured height in feet, and the distance to each obstruction. In the case of large obstructions or closely-spaced groups of obstructions, such as trees, draw the approximate shape of the areal coverage of the group, as viewed from above, and label the ranges of bearing, height, and distance.

13 Submission of Documentation

All forms and photos documenting site installation should be submitted to the ISOS Office within 5 business days after completing the installation. Electronic versions of the GEONOR precipitation gauge calibration sheet and metadata form, which include provision for entering all required information electronically, will be supplied to the maintenance contractors. These forms must be submitted in the electronic, fillable format; scanned versions will not be accepted. When scanning the installation checklist, as-built drawing, and obstruction drawing for submission, they should be scanned at 300 dpi in grayscale mode and submitted in JPEG format. All documentation should be submitted to the ISOS Office in electronic form by FTP to the following address:

IP Address: 129.15.195.100
User Name: batman
Password: bobkane

Forms should be uploaded to the directory corresponding to the state in which the station is located within the "Installation Forms" directory. Photos should be uploaded to the directory corresponding to the state in which the station is located within the "Installation_Pictures" directory.

Whenever documentation is submitted to the FTP site, send an email notification to Gavin Essenberg at Gavin.Essenberg@noaa.gov so that the metadata database can be updated as soon as possible. Use the following naming convention for all forms submitted to the FTP site:

STNIDYYYYMMDDFT.xxx

where

STNID = the 3- or 5-character station ID
YYYY = year installation completed
MM = month installation completed
DD = day of the month installation completed
FT = form type (see Table 10 below)
xxx = document extension (e.g., doc, pdf, jpg)

Table 10. Entries to use for the form type portion of an electronic form name.

Form	FT
Installation Checklist	CL
GEONOR Precipitation Gauge Calibration Sheet	GC
As-Built Drawing	AB
Metadata Form	MD
Obstruction Drawing (if submitted separately from metadata form)	OD

Example:
The following example indicates the proper naming of documentation for Andover, ME (ANDM1), which was installed on October 20, 2004:

ANDM120041020CL.jpg – installation checklist
ANDM120041020GC.doc – GEONOR calibration sheet
ANDM120041020AB.jpg – as-built drawing
ANDM120041020MD.doc – metadata form
ANDM120041020OD.jpg – obstruction drawing

Appendix

This appendix contains all of the following forms necessary for site installation, listed in the order included. The GEONOR Precipitation Calibration Sheet and Station Metadata Form are provided so that they may be printed and completed by hand in the field. If they are initially completed by hand, the data must be manually transferred to fillable electronic versions for submission. However, the obstruction drawing, included in the Station Metadata Form, should be scanned and submitted.

1. Equipment and Materials Checklist: Station with a 2-Meter Mast
2. Equipment and Materials Checklist: Station with a Single 7-Foot Tower Section
3. Equipment and Materials Checklist: Station with a Tall Tower

4. Installation Checklist: Station with a 2-Meter Mast
5. Installation Checklist: Station with a Single 7-Foot Tower Section
6. Installation Checklist: Station with a Tall Tower

7. GEONOR Precipitation Gauge Calibration Sheet

8. NERON Site As-Built Drawing

9. NERON Station Metadata Form

EQUIPMENT AND MATERIALS CHECKLIST: STATION WITH A 2-METER MAST

Units Included	Units Required	Quantity per Station	
			Mast and Accessories
		1	Mast or tower
		1 Set	Mast/tower mounting hardware
		1	Mast/tower steel screw foundation
			Concrete if unable to use steel screw foundation
		1 Set	Concrete anchoring hardware if unable to use steel screw foundation
		1	Lightning rod, aluminum or copper, w/mast mount and cable
		1	8-foot 5/8” dia. copper-clad steel ground rod
		( )	Spare ground rods if rocky soil or shallow bedrock
		1	Copper or stainless steel acorn clamp for ground rod
		( )	Spare copper or stainless steel acorn clamps (1 per spare ground rod)
		17’	6 AWG solid copper ground wire
		( )	Spare 6 AWG solid copper ground wire (2’ 5” per spare ground rod)
		1	Communication antenna
		1 Set	Communication antenna mounting hardware
		5’	Coaxial cable for antenna
			Precipitation Gauge
		1	GEONOR T-200B3W weighing bucket gauge
		1 Set	GEONOR gauge mounting hardware
		3	Vibrating wire sensors
		1	GEONOR pedestal
		1 Set	GEONOR pedestal mounting hardware
		1	Steel screw foundation
			Concrete if unable to use steel screw foundation
		1 Set	Concrete anchoring hardware if unable to use steel screw foundation
		1	Alter shield w/support arms
		1 Set	Alter shield hardware
		1	32’ Sensor cable for connection to data logger
		19’	¾” dia. water-tight non-metallic conduit

Units Included	Units Required	Quantity per Station	
			Sensors
		1	Air temperature sensor w/cable
		1	Relative humidity sensor w/cable
		1	Air temperature/relative humidity mounting arm
		1 Set	Air temperature/relative humidity mounting arm hardware
		( )	Gill radiation shield
		( )	Sets of gill radiation shield mounting hardware
		1	Dewpoint sensor w/cable
		1	Pyranometer w/cable
		1	Pyranometer mounting arm
		1	Pyranometer mounting bracket
		1 Set	Pyranometer mounting arm & bracket hardware
		1	Pyranometer mounting plate w/bubble level
		1	Barometer
		2’	Barometer inlet tubing
		1	Skin temperature sensor w/cable
		1 Set	Skin temperature sensor mounting hardware
		5	Soil moisture/temperature sensors w/cables
		59’	¾” dia. water-tight non-metallic conduit
		7’ 6”	Braided metallic protective sheathing for soil moisture/temperature cables
		5	Soil moisture plot markers
			Data Logger Enclosure and Electronics
		1	Data logger enclosure w/grounding lug and interior mounting hardware
		1 Set	Data logger enclosure mounting hardware
		1	Campbell CR10X or Vaisala QML201 data logger
		1	Vaisala DSU232-M3 comms module, if Vaisala station
		1 Set	Vaisala terminal blocks and relays, if Vaisala station
		1	Campbell XT-AMT16/32 or Vaisala QMU 101 multiplexer, if soil moisture
		3	GEONOR hybrid interfaces
		1	LETS radio, if LETS comms
		1	Cellular radio/modem, if cellular comms
		1	GOES transmitter, if GOES comms
		2	Wireless RS-232 radios, if human observer
		1	PDA, if human observer
			Miscellaneous
		~40	Plastic cable ties
			Water-tight sealing clay
		( )	Fence panels
		( )	Fence posts
		5	Gallon size plastic zipper bags for soil samples

Units Included	Units Required	Quantity per Station	
			Power
		1	Solar panel mast
		1	Solar panel mast foundation
		1	Solar panel mast lightning rod
		1	( )W Solar panel w/21' cable, if solar powered
		1 Set	Solar panel mounting hardware, if solar powered
		1	AC power transformer, if AC powered
		1	AC surge suppressor, if AC powered
		1	Voltage regulator
		1	Additional voltage regulator if Vaisala station
		( )	( )Ah Battery
		( )	Battery wire sets
		1 Set	Station power wires
		2	Fuse holder for ATO fast-acting automotive blade fuse, if required
		( )	3 amp ATO fast-acting automotive blade fuse
		( )	5 amp ATO fast-acting automotive blade fuse
		( )	7.5 amp ATO fast-acting automotive blade fuse
		1	Battery enclosure, if required
		1	Battery enclosure mounting hardware, if required
		12'	¾" dia. water-tight non-metallic conduit
			Special Tools
		1	Digital camera
		1	Post driver
		1	Post hole digger
		1	Spade
		1	Gas-powered auger
		1	Steel screw foundation wrench tool
		1 Set	Metric Allen and hex wrenches
		1	Metric ratcheting Allen wrench for confined spaces
		1 Set	Metric Allen wrenches that can work at an angle
		1	Inclinometer
		1	Compass
		1	Mirror-on-a-stick
		11	Troemer-certified machined brass 1000g precipitation calibration weights
		1	Aluminum base/centering precipitation calibration weight
		1	Precision bubble level
		1	Bi-directional RF power meter for GOES, LETS frequency bands

EQUIPMENT AND MATERIALS CHECKLIST:
STATION WITH A SINGLE 7-FOOT TOWER SECTION

Units Included	Units Required	Quantity per Station	Tower and Accessories
		1	7-foot tower section
		1	Tower top plate
		1	Hinged tower base plate
		2 Sets	Tower section mounting hardware
		6	4-foot-long L-shaped ½" or 5/8" dia. rebar rods for anchoring base plate
			Concrete if unable to use rebar
		1 Set	Concrete anchoring hardware if unable to use rebar
		40'	Guy wire cable
		15	Guy wire cable clamps
		3	Guy wire thimbles
		3	Guy wire eye and claw turnbuckles
		3	Guy wire anchors
		1	Lightning rod, aluminum or copper
		1	8-foot copper-clad steel ground rod
		( )	Spare ground rods if rocky soil or shallow bedrock
		2	Copper or stainless steel acorn clamps for lightning rod and ground rod
		( )	Spare copper or stainless steel acorn clamps (1 per spare ground rod)
		8' 6"	Copper grounding cable for lightning rod
		1	Copper or stainless steel ground wire clamp for tower
		8'	6 AWG solid copper ground wire
		( )	Spare 6 AWG solid copper ground wire (3' 5" per spare ground rod)
		1	Communication antenna
		1 Set	Communication antenna mounting hardware
		6'	Coaxial cable for antenna

Units Included	Units Required	Quantity per Station	
			Precipitation Gauge
		1	GEONOR T-200B3W weighing bucket gauge
		1 Set	GEONOR gauge mounting hardware
		3	Vibrating wire sensors
		1	GEONOR pedestal
		1 Set	GEONOR pedestal mounting hardware
		1	Steel screw foundation
			Concrete if unable to use steel screw foundation
		1 Set	Concrete anchoring hardware if unable to use steel screw foundation
		1	Alter shield w/support arms
		1 Set	Alter shield hardware
		1	32’ Sensor cable for connection to data logger
		26’	¾” dia. water-tight non-metallic conduit
			Sensors
		1	Air temperature sensor w/cable
		1	Relative humidity sensor w/cable
		1	Air temperature/relative humidity mounting arm
		1 Set	Air temperature/relative humidity mounting arm hardware
		( )	Gill radiation shields
		( )	Sets of gill radiation shield mounting hardware
		1	Dewpoint sensor w/cable
		1	Cup anemometer w/cable
		1	Cup anemometer mounting arm
		1 Set	Cup anemometer mounting arm hardware
		1	Pyranometer w/cable
		1	Pyranometer mounting arm
		1	Pyranometer mounting bracket
		1 Set	Pyranometer mounting arm & bracket hardware
		1	Pyranometer mounting plate w/bubble level
		1	Barometer
		2’	Barometer inlet tubing
		1	Skin temperature sensor w/cable
		1 Set	Skin temperature sensor mounting hardware
		5	Soil moisture/temperature sensors w/cables
		73’	¾” dia. water-tight non-metallic conduit
		7’ 6”	Braided metallic protective sheathing for soil moisture/temperature cables
		5	Soil moisture plot markers

Units Included	Units Required	Quantity per Station	
			Data Logger Enclosure and Electronics
		1	Data logger enclosure w/grounding lug and interior mounting hardware
		1 Set	Data logger enclosure mounting hardware
		1	Campbell CR10X or Vaisala QML201 data logger
		1	Vaisala DSU232-M3 comms module, if Vaisala station
		1 Set	Vaisala terminal blocks and relays, if Vaisala station
		1	Campbell XT-AMT16/32 or Vaisala QMU 101 multiplexer, if soil moisture
		3	GEONOR hybrid interfaces
		1	LETS radio, if LETS comms
		1	Cellular radio/modem, if cellular comms
		1	GOES transmitter, if GOES comms
		2	Wireless RS-232 radios, if human observer
		1	PDA, if human observer
			Power
		1	Solar panel mast, if required
		1	Solar panel mast foundation, if required
		1	Solar panel mast lightning rod, if required
		1	( )W Solar panel w/5' cable (21' cable if mounted on separate mast)
		1 Set	Solar panel mounting hardware, if solar powered
		1	AC power transformer, if AC powered
		1	AC surge suppressor, if AC powered
		1	Voltage regulator
		1	Additional voltage regulator if Vaisala station
		( )	( )Ah Battery
		( )	Battery wire sets
		1 Set	Station power wires
		2	Fuse holder for ATO fast-acting automotive blade fuse, if required
		( )	3 amp ATO fast-acting automotive blade fuse
		( )	5 amp ATO fast-acting automotive blade fuse
		( )	7.5 amp ATO fast-acting automotive blade fuse
		1	Power equipment enclosure, if required
		1	Power equipment enclosure mounting hardware, if required
		12'	¾" dia. water-tight non-metallic conduit, if solar panel mast required
			Miscellaneous
		~50	Plastic cable ties
			Water-tight sealing clay
		( )	Fence panels
		( )	Fence posts
		5	Gallon size plastic zipper bags for soil samples

Units Included	Units Required	Quantity per Station	Special Tools
		1	Digital camera
		1	Post driver
		1	Post hole digger
		1	Spade
		1	Gas-powered auger
		1	Steel screw foundation wrench tool
		1 Set	Metric Allen and hex wrenches
		1	Metric ratcheting Allen wrench for confined spaces
		1 Set	Metric Allen wrenches that can work at an angle
		1	Inclinometer
		1	Compass
		1	Mirror-on-a-stick
		11	Troemer-certified machined brass 1000g precipitation calibration weights
		1	Aluminum base/centering precipitation calibration weight
		1	Precision bubble level
		1	Bi-directional RF power meter for GOES, LETS frequency bands

EQUIPMENT AND MATERIALS CHECKLIST: STATION WITH A TALL TOWER

Units Included	Units Required	Quantity per Station	Tower and Accessories
		3	7-foot tower section
		1	9-foot tapered tower section
		4 Sets	Tower section mounting hardware
		1	Hinged tower base plate
		6	4-foot-long L-shaped ½" or 5/8" dia. rebar rods for anchoring base plate
			Concrete if unable to use rebar
		1 Set	Concrete anchoring hardware if unable to use rebar
		160'	Guy wire cable
		15	Guy wire cable clamps
		3	Guy wire thimbles
		3	Guy wire eye and claw turnbuckles
		3	4' guy wire screw anchors
		1	Lightning rod, aluminum or copper
		1	Lightning rod cable connector
		2	Lightning rod mounting arms
		1	8-foot copper-clad steel ground rod
		( )	Spare ground rods if rocky soil or shallow bedrock
		1	Large ground rod cable clamp
		( )	Spare small ground rod cable clamps (1 per spare ground rod)
		29'	Aluminum grounding cable for lightning rod
		2'	Copper grounding cable for lightning rod
		1	Stainless steel grounding cable splicing clamp
		1	Copper or stainless steel ground wire clamp for tower
		8'	6 AWG solid copper ground wire
		( )	Spare 6 AWG solid copper ground wire (3' 5" per spare ground rod)
		1	Communication antenna
		1 Set	Communication antenna mounting hardware
		27'	Coaxial cable for antenna

Units Included	Units Required	Quantity per Station	
			Precipitation Gauge
		1	GEONOR T-200B3W weighing bucket gauge
		1 Set	GEONOR gauge mounting hardware
		3	Vibrating wire sensors
		1	GEONOR pedestal
		1 Set	GEONOR pedestal mounting hardware
		1	Steel screw foundation
			Concrete if unable to use steel screw foundation
		1 Set	Concrete anchoring hardware if unable to use steel screw foundation
		1	Alter shield w/support arms
		1 Set	Alter shield hardware
		1	32’ Sensor cable for connection to data logger
		26’	¾” dia. water-tight non-metallic conduit
			Sensors
		1	Air temperature sensor w/cable
		1	Relative humidity sensor w/cable
		1	Air temperature/relative humidity mounting arm
		1 Set	Air temperature/relative humidity mounting arm hardware
		( )	Gill radiation shields
		( )	Sets of gill radiation shield mounting hardware
		1	Dewpoint sensor w/cable
		1	Cup anemometer w/cable
		1	Cup anemometer mounting arm
		1 Set	Cup anemometer mounting arm hardware
		1	Prop vane anemometer w/cable
		1	Prop vane anemometer mounting pipe
		1	Pyranometer w/cable
		1	Pyranometer mounting arm
		1	Pyranometer mounting bracket
		1 Set	Pyranometer mounting arm & bracket hardware
		1	Pyranometer mounting plate w/bubble level
		1	Barometer
		2’	Barometer inlet tubing
		1	Skin temperature sensor w/cable
		1 Set	Skin temperature sensor mounting hardware
		5	Soil moisture/temperature sensors w/cables
		73’	¾” dia. water-tight non-metallic conduit
		7’ 6”	Braided metallic protective sheathing for soil moisture/temperature cables
		5	Soil moisture plot markers

Units Included	Units Required	Quantity per Station	
			Data Logger Enclosure and Electronics
		1	Data logger enclosure w/grounding lug and interior mounting hardware
		1 Set	Data logger enclosure mounting hardware
		1	Campbell CR10X or Vaisala QML201 data logger
		1	Vaisala DSU232-M3 comms module, if Vaisala station
		1 Set	Vaisala terminal blocks and relays, if Vaisala station
		1	Campbell XT-AMT16/32 or Vaisala QMU 101 multiplexer, if soil moisture
		3	GEONOR hybrid interfaces
		1	LETS radio, if LETS comms
		1	Cellular radio/modem, if cellular comms
		1	GOES transmitter, if GOES comms
		2	Wireless RS-232 radios, if human observer
		1	PDA, if human observer
			Power
		1	( )W Solar panel w/18' cable, if solar powered
		1 Set	Solar panel mounting hardware, if solar powered
		1	AC power transformer, if AC powered
		1	AC surge suppressor, if AC powered
		1	Voltage regulator
		1	Additional voltage regulator if Vaisala station
		( )	( )Ah Battery
		( )	Battery wire sets
		1 Set	Station power wires
		2	Fuse holder for ATO fast-acting automotive blade fuse, if required
		( )	3 amp ATO fast-acting automotive blade fuse
		( )	5 amp ATO fast-acting automotive blade fuse
		( )	7.5 amp ATO fast-acting automotive blade fuse
		1	Power equipment enclosure, if required
		1	Power equipment enclosure mounting hardware, if required
			Miscellaneous
		~100	Plastic cable ties
			Water-tight sealing clay
		( )	Fence panels
		( )	Fence posts
		5	Gallon size plastic zipper bags for soil samples

Units Included	Units Required	Quantity per Station	Special Tools
		1	Digital camera
		1	Post driver
		1	Post hole digger
		1	Spade
		1	Gas-powered auger
		1	Steel screw foundation wrench tool
		1 Set	Metric Allen and hex wrenches
		1	Metric ratcheting Allen wrench for confined spaces
		1 Set	Metric Allen wrenches that can work at an angle
		1	Inclinometer
		1	Compass
		1	Mirror-on-a-stick
		11	Troemer-certified machined brass 1000g precipitation calibration weights
		1	Aluminum base/centering precipitation calibration weight
		1	Precision bubble level
		1	Bi-directional RF power meter for GOES, LETS frequency bands

INSTALLATION CHECKLIST:
STATION WITH A 2-METER MAST

(Use only **BLACK INK** to facilitate scanning)

STATION ID	DATE	INSTALLER

Use initials to indicate that step has been completed

	Site verified clear of underground utility lines
	If utility lines present, locations marked and can be avoided in site installation
	Frost line depth information obtained
	Pre-installation photos taken
	Vegetation cut
	Mast anchor/foundation hole photo taken, if applicable
	Lightning rod mounted and cable routed
	Main mast/tower foundation installed
	Precipitation gauge anchor/foundation hole photo taken, if applicable
	Precipitation gauge foundation installed
	Solar panel mast, foundation, and lightning rod installed
	Main mast/tower and precipitation gauge pedestal installed
	Ground rod/plate/mesh driven
	Additional ground rods driven, if needed
	Conduit installed between main mast and solar panel mast
	Conduit installed between the main mast and the precipitation gauge pedestal
	Air temperature/relative humidity radiation shields and arm mounted at 1.5 meters
	Logger enclosure mounted to mast/tower
	Battery enclosure mounted to mast/tower, if applicable
	Pyranometer mounting arm and plate mounted, if applicable
	Logger enclosure, main mast/tower, and solar panel mast connected to east ground rod
	All ground rods connected directly to east ground rod
	Lightning rod grounding cable connected to east ground rod
	Communication antenna mounted and connected to radio
	Solar panel mounted to solar panel mast and tilt set, if solar powered
	Photo taken of AC power line trench, if AC powered and visible
	Buried AC power line locations in plot shown on as-built drawing
	Circuit breaker and surge suppressor installed, if AC powered
	Fuse installed between battery and station
	Fuse installed between battery and precipitation gauge heater
	Battery connected to regulator and to station and station powered up
	Charging source connected to regulator(s) and charging verified
	Program/setup downloaded to data logger
	LETS radio, cellular modem, or GOES transmitter installed, configured, and tested
	Air temperature probe installed and reading verified
	Relative humidity probe installed and reading verified, if provided
	Pyranometer installed and reading verified, if provided

	Precipitation gauge installed
	Precipitation gauge calibrated and calibration sheet complete
	2” soil moisture/temperature photo taken, if sensor provided
	4” soil moisture/temperature photo taken, if sensor provided
	8” soil moisture/temperature photo taken, if sensor provided
	20” soil moisture/temperature photo taken, if sensor provided
	40” soil moisture/temperature photo taken, if sensor provided
	2” soil moisture/temperature sensor installed, and reading verified, if provided
	4” soil moisture/temperature sensor installed and reading verified, if provided
	8” soil moisture/temperature sensor installed and reading verified, if provided
	20” soil moisture/temperature sensor installed and reading verified, if provided
	40” soil moisture/temperature sensor installed and reading verified, if provided
	Ground repaired over all trenches
	Fence installed, if necessary
	16 units of desiccant put in logger enclosure, if applicable
	Logger enclosure cable entry points sealed, if applicable
	All sensor readings verified
	Positive communication and data collection verified between station and NERON monitoring facility
	4 post-installation photos looking toward station taken
	Cover shot photo taken
	Mast/precipitation foundation photos taken, if applicable
	Soil moisture/temperature plot photos taken
	As-built drawing complete
	Station metadata form complete
	GEONOR calibration sheet submitted to ISOS Program Office
	Photos named as specified and submitted to ISOS Program Office
	As-built drawing submitted to ISOS Program Office
	Station metadata form submitted to ISOS Program Office
	Installation checklist submitted to ISOS Program Office

INSTALLATION CHECKLIST:
STATION WITH A SINGLE 7-FOOT TOWER SECTION

(Use only **BLACK INK** to facilitate scanning)

STATION ID	DATE	INSTALLER

Use initials to indicate that step has been completed

	Site verified clear of underground utility lines
	If utility lines present, locations marked and can be avoided in site installation
	Frost line depth information obtained
	Pre-installation photos taken
	Vegetation cut
	Tower anchor/foundation hole photo taken, if applicable
	Tower base plate installed
	Precipitation gauge anchor/foundation hole photo taken, if applicable
	Precipitation gauge foundation and pedestal installed
	Guy wire anchors installed
	Ground rod/plate/mesh installed
	Additional ground rods driven, if needed
	Tower top plate installed
	Lightning rod installed and grounding cable clamped to rod
	Tower section installed upright on base plate and hinged part secured
	Conduit installed between tower and precipitation gauge
	Guy wires installed, tower plumb, tension adjusted
	Guy wire turnbuckle safety cables installed
	Air temperature/relative humidity radiation shields and arm mounted at 1.5 meters
	Pyranometer mounting arm and plate mounted, if applicable
	Cup anemometer and arm mounted at 2 meters
	Logger enclosure mounted to northwest side of tower
	Solar panel mast installed w/lightning rod, if applicable
	Solar panel mounted to south side of tower or solar panel mast and tilt set, if solar powered
	Battery enclosure mounted to northeast side of tower, if applicable
	Lightning rod grounding cable routed and secured to southeast leg of tower
	All ground rods connected directly to east ground rod
	Logger enclosure, tower, and (if applicable) solar panel mast connected to east ground rod
	Lightning rod grounding cable connected to east ground rod
	Communication antenna mounted and connected to radio
	Photo taken of AC power line trench, if AC powered and visible
	Buried AC power line locations in plot shown on as-built drawing
	Photo taken of AC power line trench, if AC powered and possible
	Circuit breaker and surge suppressor installed, if AC powered
	Fuse installed between battery and station
	Fuse installed between battery and precipitation gauge heater
	Battery connected to regulator and to station and station powered up

	Charging source connected to regulator and charging verified
	Program/setup downloaded to data logger
	LETS radio, cellular modem, or GOES transmitter installed, configured, and tested
	Air temperature probe installed and reading verified
	Relative humidity probe installed and reading verified, if provided
	Pyranometer installed and reading verified, if provided
	Cup anemometer connected to data logger and reading verified, if provided
	Precipitation gauge installed
	Precipitation gauge calibrated and calibration sheet complete
	2” soil moisture/temperature photo taken, if sensor provided
	4” soil moisture/temperature photo taken, if sensor provided
	8” soil moisture/temperature photo taken, if sensor provided
	20” soil moisture/temperature photo taken, if sensor provided
	40” soil moisture/temperature photo taken, if sensor provided
	2” soil moisture/temperature sensor installed, and reading verified, if provided
	4” soil moisture/temperature sensor installed and reading verified, if provided
	8” soil moisture/temperature sensor installed and reading verified, if provided
	20” soil moisture/temperature sensor installed and reading verified, if provided
	40” soil moisture/temperature sensor installed and reading verified, if provided
	Ground repaired over all trenches
	Fence installed, if necessary
	16 units of desiccant placed in logger enclosure, if applicable
	Logger enclosure cable entry points sealed, if applicable
	All sensor readings verified
	Positive communication and data collection verified between station and NERON monitoring facility
	As-built drawing complete
	Station metadata form complete
	4 post-installation photos looking toward station taken
	Cover shot photo taken
	Mast/precipitation foundation photos taken, if applicable
	Soil moisture/temperature plot photos taken
	GEONOR calibration sheet submitted to ISOS Program Office
	Photos named as specified and submitted to ISOS Program Office
	As-built drawing submitted to ISOS Program Office
	Station metadata form submitted to ISOS Program Office
	Installation checklist submitted to ISOS Program Office

INSTALLATION CHECKLIST:
STATION WITH A TALL TOWER

(Use only **BLACK INK** to facilitate scanning)

STATION ID	DATE	INSTALLER

Use initials to indicate that step has been completed

	Site verified clear of underground utility lines
	If utility lines present, locations marked and can be avoided in site installation
	Frost line depth information obtained
	Pre-installation photos taken
	Vegetation cut
	Tower foundation hole photo taken, if applicable
	Tower base plate installed
	Precipitation gauge anchor/foundation hole photo taken, if applicable
	Precipitation gauge steel screw foundation and pedestal installed
	Guy wire anchors installed
	Ground rod/plate/mesh installed
	Additional ground rods driven, if needed
	Tower sections bolted together and bolted to base plate
	Air temperature/relative humidity radiation shields and arm mounted at 1.5 meters
	Pyranometer mounting arm and plate mounted, if provided
	Cup anemometer and arm mounted at 2 meters
	Logger enclosure mounted to northwest side of tower
	Battery enclosure mounted to south side of tower, if applicable
	Solar panel mounted to south side of tower and tilt set, if solar powered
	Lightning rod mounted and grounding cable connected and routed along southeast tower leg
	Guy wires attached to tower
	Winch cable attached to tower with eye or hook attached to free end
	Communication antenna mounted and connected to radio
	Photo taken of AC power line trench, if AC powered and visible
	Buried AC power line locations in plot shown on as-built drawing
	Photo taken of AC power line trench, if AC powered and possible
	Circuit breaker and surge suppressor installed, if AC powered
	Fuse installed between battery and station
	Fuse installed between battery and precipitation gauge heater
	Battery connected to regulator and to station and station powered up
	Charging source connected to regulator and charging verified
	Program/setup downloaded to data logger
	LETS radio, cellular modem, or GOES transmitter installed, configured, and tested
	Air temperature probe installed and reading verified
	Relative humidity probe installed and reading verified, if provided
	Pyranometer installed and reading verified, if provided

	Cup anemometer connected to data logger and reading verified, if provided
	Prop vane installed
	Prop vane directional sensor oriented relative to true north
	Guy wire turnbuckles attached to anchors and N and SE guy wires attached to turnbuckles
	SW guy wire attached to unscrewed turnbuckle eye
	Tower raised, guy wires secure
	Hinged section of tower base bolted to base plate
	Tower plumb and guy wire tension neither too loose nor too tight
	Guy wire turnbuckle safety cables installed
	Winch cable secured to bottom of tower
	All ground rods connected directly to east ground rod
	Logger enclosure and mast connected to east ground rod
	Lightning rod grounding cable connected to east ground rod
	Conduit installed between tower and precipitation gauge
	Precipitation gauge installed
	Precipitation gauge calibrated and calibration sheet complete
	2” soil moisture/temperature photo taken, if sensor provided
	4” soil moisture/temperature photo taken, if sensor provided
	8” soil moisture/temperature photo taken, if sensor provided
	20” soil moisture/temperature photo taken, if sensor provided
	40” soil moisture/temperature photo taken, if sensor provided
	2” soil moisture/temperature sensor installed, and reading verified, if provided
	4” soil moisture/temperature sensor installed and reading verified, if provided
	8” soil moisture/temperature sensor installed and reading verified, if provided
	20” soil moisture/temperature sensor installed and reading verified, if provided
	40” soil moisture/temperature sensor installed and reading verified, if provided
	Ground repaired over all trenches
	Fence installed, if necessary
	16 units of desiccant placed in logger enclosure, if applicable
	Logger enclosure cable entry points sealed, if applicable
	All sensor readings verified
	Positive communication and data collection verified between station and NERON monitoring facility
	As-built drawing complete
	Station metadata form complete
	4 post-installation photos looking toward station taken
	Cover shot photo taken
	Mast/precipitation foundation photos taken, if applicable
	Soil moisture/temperature plot photos taken
	GEONOR calibration sheet submitted to ISOS Program Office
	Photos named as specified and submitted to ISOS Program Office
	As-built drawing submitted to ISOS Program Office
	Station metadata form submitted to ISOS Program Office

☐ Installation checklist submitted to ISOS Program Office

Form Date: November 11, 2004

GEONOR PRECIPITATION GAUGE CALIBRATION SHEET

STATION ID	DATE	PERFORMED BY	PERFORMER AFFILIATION

GAUGE BASE SERIAL NO.	BUCKET SERIAL NO.

	VIBRATING WIRE 1	VIBRATING WIRE 2	VIBRATING WIRE 3
	SERIAL NO.	SERIAL NO.	SERIAL NO.
WEIGHT (g)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)
0			
1000			
2000			
3000			
4000			
5000			
6000			
7000			
8000			
9000			
10000			
11000			
12000			
F_o (e^0)			
A (e^{-2})			
B (e^{-6})			

NERON STATION AS-BUILT DRAWING

There is a hypothetical standard configuration for a Weather Reference Network station with a given plot size and tower/mast type, but deviations may be necessary at the discretion of the installer. The drawing below shows the site as-built. List or show all variations from the standard NERON configuration, and indicate the routing of all sub-surface conduit and lines, the locations of all ground rods, plates, and/or mesh matrices, and the heights and depths of all sensors installed, whether or not they conform exactly to specifications.

STATION ID	DATE	PLOT SIZE	INSTALLER
		10x16 16x20 20x40	

As-Built:

Form Date: March 10, 2005

NERON STATION METADATA FORM

☐ Initial Installation ☐ Move ☐ Update (enter only changed information after first two lines)

STATION ID	STATION NAME	STATION TYPE	UTC DATE EFFECTIVE	UTC TIME EFFECTIVE
		REMO RPTR BASE		

INSTALLER/MAINTAINER	COOP NO.	WBAN NO.

SITE INFORMATION

LATITUDE (DEG, TO 5 DECIMAL PLACES)	LONGITUDE (DEG, TO 5 DECIMAL PLACES)	ELEVATION (FT)	UTC OFFSET (STD TIME)	MAGNETIC DECLINATION

LAT/LON SOURCE	ELEV SOURCE	HORIZ. COORDINATE REF DATUM	VERT. COORDINATE REF DATUM

STATE	COUNTY	CLIMATE DIVISION	WFO CWA ID	GOV'T PROPERTY ID

PLOT SIZE	FENCE INSTALLED?	FENCE TYPE
10x16 16x20 20x40	Y N	

POWER TYPE	LOGGER ENCLOSURE HEATER INSTALLED?	NO. OF GROUND RODS	NO. OF GROUND PLATES	NO. OF MESH GROUND POINTS
SOLAR AC	Y N			

BASIC SENSORS INSTALLED

	MANUFACTURER	MODEL NO.	SERIAL NO.
TAIR			

	MANUFACTURER	MODEL NO.	BASE SERIAL NO.	BUCKET SERIAL NO.
PRECIP				

	VIBRATING WIRE 1 SERIAL NO.	F_o	A	B
VWPCP1				

	VIBRATING WIRE 2 SERIAL NO.	F_o	A	B
VWPCP2				

	VIBRATING WIRE 3 SERIAL NO.	F_o	A	B
VWPCP3				

TYPE OF GAUGE	HEIGHT OF RAIN GAUGE INLET	HEATER INSTALLED?	HEATER MANUFACTURER	HEATER MODEL NO.
WEIGHING TIPPING	in.	Y N		

TYPE OF ANTIFREEZE	TYPE OF OIL	AMOUNT OF ANTIFREEZE ADDED
		L

ENHANCED SENSORS INSTALLED

	MANUFACTURER	MODEL NO.	SERIAL NO.
RELH			
DEWPNT			
WTRVAP			
WS2M			
WSPD			
WDIR			
PRES			
SRAD			

IRTT	MANUFACTURER	MODEL NO.	SERIAL NO.
FW005	MANUFACTURER	MODEL NO.	SERIAL NO.
FW010	MANUFACTURER	MODEL NO.	SERIAL NO.
FW020	MANUFACTURER	MODEL NO.	SERIAL NO.
FW051	MANUFACTURER	MODEL NO.	SERIAL NO.
FW102	MANUFACTURER	MODEL NO.	SERIAL NO.

EQUIPMENT INSTALLED

LOGG	MANUFACTURER	MODEL NO.	SERIAL NO.	
	OS/FIRMWARE VERSION	PROGRAM/SETUP NAME	PROGRAM/SETUP VERSION	PAKBUS ID (CSI ONLY)
WIRPAN	MANUFACTURER	MODEL NO.	SERIAL NO.	
PRTMOD	MANUFACTURER	MODEL NO.	SERIAL NO.	
MUX	MANUFACTURER	MODEL NO.	SERIAL NO.	
RADIO	MANUFACTURER	MODEL NO.	SERIAL NO.	

TYPE LETS	LETS FREQUENCY/BAND (MHz)	LETS RF ID	LETS SUBNET ID	LETS PRIMARY BASE ID	
CDMA	CELL SERVICE PROVIDER	CELL ESN/EIN	CELL MDN	CELL MIN/MSID	
GSM	CELL IP ADDRESS	CELL NETWORK ACCESS ID	CELL SID	CELL NID	CELL FREQUENCY BAND
GOES	GOES NESDIS ID	GOES BAUD 100 300 1200	GOES NESDIS CHANNEL	GOES TXER CHANNEL	
	GOES TX TIME (s)	GOES WINDOW (s)	GOES INTERVAL (s)		

ANTENNA HEIGHT (FT)	ANTENNA TYPE DIPOLE YAGI GOES YAGI OMNI	NO. YAGI ELEMENTS	ANTENNA AZIMUTH	ANTENNA INCLINATION

RFMODM	MANUFACTURER	MODEL NO.	SERIAL NO.	
RS232IF	MANUFACTURER	MODEL NO.	SERIAL NO.	
SERSRV	MANUFACTURER	MODEL NO.	SERIAL NO.	
ETHHUB	MANUFACTURER	MODEL NO.	SERIAL NO.	
ROUTER	MANUFACTURER	MODEL NO.	SERIAL NO.	
SOLRP	MANUFACTURER	MODEL NO.	SERIAL NO.	INCLINATION
SOLRPS	MANUFACTURER	MODEL NO.	SERIAL NO.	INCLINATION
ACTRAN	MANUFACTURER	MODEL NO.	SERIAL NO.	

SRGSUP	MANUFACTURER	MODEL NO.	SERIAL NO.
TPS	MANUFACTURER	MODEL NO.	SERIAL NO.
VREG	MANUFACTURER	MODEL NO.	SERIAL NO.
VREGS	MANUFACTURER	MODEL NO.	SERIAL NO.
BATCHG	MANUFACTURER	MODEL NO.	SERIAL NO.
BATV	MANUFACTURER	MODEL NO.	SERIAL NO.
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.
SERADS	MANUFACTURER	MODEL NO.	SERIAL NO.
SERADH	MANUFACTURER	MODEL NO.	SERIAL NO.
PDA	MANUFACTURER	MODEL NO.	SERIAL NO.

SITE ACCESS

Will NWS and NWS contractors have unrestricted access to the site and be able to work late and on weekends?
☐ Yes ☐ No

LOCKED GATE?	NWS LOCK ALLOWED?	NWS LOCK INSTALLED?	NO. OF KEYS ACQUIRED	KEY NUMBER/ID	LOCK COMBO (IF APPLICABLE)
Y N	Y N	Y N			

If a LETS agency, will identification be required to enter the premises?
☐ Yes ☐ No

List any site access restrictions that will be in place below:

Can 2WD vehicles drive to the site throughout the year? ☐ Yes ☐ No

Can 4WD vehicles drive to the site throughout the year? ☐ Yes ☐ No

If not, for either case, explain below:

Does the site host prefer not to have vehicles driven off-road under certain conditions or have any restrictions on the route that is driven to the site on the host's land? ☐ Yes ☐ No

If so, explain below:

SITE DRIVING DIRECTIONS

(From the intersection of two US/state highways or from an interstate highway exit to the site)

SITE HOST SPECIAL INSTRUCTIONS

How does the host prefer that vegetation cuttings be disposed of?

☐ No preference ☐ Single pile outside plot ☐ Spread evenly outside plot ☐ Bagged and carried away

☐ Other, explain below:

Other special instructions:

SITE CONTACT INFO

CONTACT			
ADDRESS 1			
ADDRESS 2			
CITY		STATE	ZIP
PHONE	FAX	EMAIL	

NOTES

OBSTRUCTIONS

(Use only **BLACK INK** to facilitate scanning)

Draw each obstruction within 330 feet (100 meters) of the center of the plot, label its bearing from the center of the plot in degrees relative to true north, its height in feet, and its distance from the center of the plot in feet below. The center of the circle below indicates the center of the plot and the edge of the circle represents the extent of the 330-foot range.